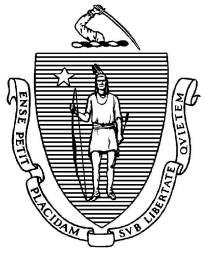

Commonwealth of Massachusetts

Office of Consumer Affairs and Business Regulation

Energy Efficiency Activities 1999
A Report by the Division of Energy Resources

An Annual Report to the Great and General Court on the Status of Energy Efficiency Activities in Massachusetts

Spring 2001

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This report is posted on the Division's website at http://www.state.ma.us/doer.

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EXECUTIVE SUMMARY

The Electric Industry Restructuring Act [St. 1997, c. 164], or "the Act," implicitly recognized that energy efficiency investments:

- Reduce overall electricity costs without reducing comfort or convenience
- Lower harmful air emissions
- Create jobs and stimulate the economy
- Enhance system reliability.

In recognition of these benefits, the Act established an energy efficiency charge over a five-year period (1998-2002) to support energy efficiency investments, including the installation of high efficiency lighting, motors, air conditioners and appliances; construction of high efficiency homes and commercial buildings; and retrofit of existing structures. In addition to recognizing the potential benefits of energy efficiency activities, the Act directed the Division of Energy Resources ("the Division") to establish statewide energy efficiency goals and to report annually on progress toward the goals. This report, the second of five between 1998 and 2002, describes progress toward those goals. In it, the Division reviews and analyzes 1999 energy efficiency investments supported by electric ratepayer-funded programs ("the Programs"), and the development of competitive markets for energy efficiency products and services.

1999 HIGHLIGHTS

The Division's major findings for 1999 are:

1. Energy Efficiency Investments Benefit All Customers by Improving System Reliability and Lowering Wholesale Electricity Prices.

The 1999 Programs provided system-wide benefits by enhancing generating system reliability, as well as local transmission and distribution networks, during peak usage periods. In addition, the Programs helped to avoid higher wholesale energy clearing prices. For example, the Division estimates that on June 7, 1999 alone (over a 13-hour peak period), 115 MW of demand savings from Program activities may have avoided over $6 million in additional costs to the electric system – costs that would likely have been passed on to all customers.

2. 1999 Program Participants Saved Money.

Program participants saved over $20 million on their 1999 electricity bills. Assuming that the energy efficiency equipment installed in 1999 remains in place for its full lifetime (an average of fourteen years), total savings are projected to grow to approximately $285 million. Average 1999 electricity bill savings for low-income participants was 10 percent, compared to 4 percent for all other residential participants. Average savings for small, medium and large commercial and industrial (C&I) customers were 7, 3, and 3 percent, respectively.

3. Energy Efficiency is Cheaper than Buying Electricity.

A total of $159 million was invested in Program activities in 1999 (comprised of $125 million collected from ratepayers and $34 million in participant costs), and an estimated 3,822 million kilowatt-hours will be saved over the lifetime of those investments. This equates to a cost of conserved energy of 4.2¢/kWh – almost 60 percent less than the projected average retail electricity price of 10.2¢/kWh over the same period.

4. Energy Efficiency Programs Improve Air Quality in Massachusetts and the Region.

1999 Programs improved air quality in the state and region, reducing emissions of NO_X, SO_2, and CO_2 by 453 tons, 770 tons, and 145,000 tons in 1999 alone, respectively. Over the lifetime of the measures installed in 1999, the emission reduction impacts of these pollutants may be substantially greater.

5. Energy Efficiency Programs Increase Jobs in the Commonwealth.

Program activities generated an estimated 1,060 net new jobs in Massachusetts in 1999, contributing $72 million to the gross regional product. In addition, $40 million in disposable personal income was gained from these jobs, concentrating in the services, retail trade and manufacturing sectors.

6. Energy Efficiency Programs were Cost-Effective in 1999.

According to the methodology approved by the Department of Telecommunications and Energy (the Department), Programs were cost-effective (i.e., they had an overall benefit-cost ratio) of 1.6. Under the methodology, benefits are defined as wholesale electricity and distribution and transmission costs avoided by distribution companies due to Program savings over the lifetime of 1999 installations. Costs are simply those expended on Program activities in 1999.

1999 developments included the Department's issuance of new Cost-Effectiveness Guidelines (Docket 98-100). These guidelines set out a more comprehensive methodology for quantifying energy and non-energy benefits of Programs. Consequently, their cost-effectiveness will likely increase in the future.

7. Low-income Funding Levels were Consistent with the Act.

Nearly 18,000 low-income households received over $11 million in products and services, including refrigerator replacements and home weatherizations, through low-income programs administered primarily by the Low-income Energy Affordability Network. Savings from these programs resulted in an average annual electricity bill reduction of $47 in 1999 for participating households.

8. Allocation of Funds to Different Customer Sectors Needs Improvement.

On a percentage basis, available energy efficiency funds (1999 collections and carryover from previous year) for customer sectors were as follows: Low-income (6 percent), Residential (30 percent), and C&I (64 percent). Expenditures for these sectors (plus year-end fund balances) were allocated 8, 26, and 66 percent, respectively. The Residential sector fully subsidized the Low-income sector, and slightly subsidized the C&I sector as well. The Division is working with Program Administrators to ensure that, in the future, both the Residential and C&I sectors proportionately subsidize the Low-income sector.

9. Program Activities are Balancing Short and Long Term Savings.

1999 Program activities provided participating customers with immediate savings through reduced electricity bills. *Participants* will also benefit from future savings over the life of the higher efficiency equipment installed in 1999. Other programs offered in 1999, such as regional market transformation programs, are directly paving the way for future savings for *all customers* by encouraging manufacturers, builders, engineers, architects, and retailers to change their production, purchasing, design, and stocking practices in favor of higher efficiency products and services over the long-term.

10. 1999 Energy Efficiency Product & Service Offerings by Competitive Retail Suppliers Declined.

The Division observed a decline in energy efficiency services offered by competitive retail suppliers. While most suppliers offered energy efficiency related services in 1998, fewer did in 1999, a trend that may be due partly to the limited activity in the electricity market in general, but also due to certain barriers customers face (e.g., paying for up front costs of energy audits), and a greater emphasis being placed on other energy cost savings strategies, such as load management services.

Conclusions and Future Outlook

The Division concludes that 1999 energy efficiency program activities continue to meet or make progress toward the statewide energy efficiency goals. Program activities provided direct benefits to participating customers as well as indirect benefits to the Commonwealth as a whole. The impact of 1999 program activities, combined with experience from other years, will serve as a basis for the Division's recommendation to the Legislature during 2001 concerning the future of electric ratepayer-funded energy efficiency activities beyond 2002. This assessment will also be informed by research results regarding remaining energy efficiency opportunities in the State, barriers that customers face to investing in energy efficiency, and the extent that competitive and energy efficiency service providers are providing energy efficiency services to customers.

CHAPTER 1: INTRODUCTION

1.1 Legislative Background

The Electric Industry Restructuring Act [St. 1997, c. 164], or "the Act," created a framework to transform the electric utility industry in Massachusetts from a vertically-integrated monopoly structure to a competitive model.[1] This long-term evolution of the electricity industry is expected to provide substantial benefits to customers through competitive wholesale and retail markets for electricity and other related services, such as energy efficiency.

The Act also codified the Commonwealth's policy on energy efficiency: ratepayers should continue to support energy efficiency services in the absence of market-driven energy efficiency services. Therefore, ratepayer funding for energy efficiency programs was mandated to continue through 2002 at decreasing levels of 3.3 mills[2]/kWh in 1998, 3.1 mills/kWh in 1999, 2.85 mills/kWh in 2000, 2.7 mills/kWh in 2001, and 2.5 mills/kWh in 2002. The Act further established permanent program funding for Low-income[3] customers, recognizing that markets are less likely to offer energy efficiency benefits to these customers.

With the objective of creating a fully competitive energy efficiency market, the mandated energy efficiency charge was set up for only a five-year period. During this time, the Division is charged with monitoring the competitive energy markets relative to energy efficient products and services, and to determine whether ratepayer funding should continue beyond 2002.

The Division was also assigned several new energy efficiency responsibilities, including three distinct oversight tasks related to electric ratepayer-funded program activities ("Programs" or "Program activities"):

1. Develop statewide energy efficiency goals;
2. Oversee Program activities[4]; and
3. File annual reports with the Legislature.

Progress on the above is discussed below. See Appendix B for relevant sections of the Restructuring Act pertaining the Division's above mandates.

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[1] Prior to restructuring, electric utilities owned the distribution, transmission and generation components of electricity production and delivery. Today, electric distribution companies own the distribution and transmission components only, and divested (i.e., sold) their generation assets to competitive suppliers.

[2] A mill is one-tenth of a cent or one-thousandth of a dollar. For definitions of this and other terms throughout this report, please refer to Appendix A: *Glossary of Terms.*

[3] Throughout this report, "Low-income" customers are defined as those that meet 175% of the federal poverty level, and are eligible for the residential discount rate, pursuant to the Act. Non-Low-income residential customers are referred to simply as "Residential" customers throughout the report.

[4] As directed by the Legislature in the Act, the Division promulgated regulations 225 CMR 11.00 (and supporting guidelines) regarding its oversight of electric ratepayer-funded energy efficiency activities. The Massachusetts Register published these regulations in September 1999.

1.2 Division of Energy Resources' Activities

1.2.1. Development of Statewide Energy Efficiency Goals

The Division developed statewide energy efficiency goals through an extensive process involving key stakeholders. Program Administrators (i.e., Massachusetts electric distribution companies) are directed by the Division to develop their energy efficiency plans according to these goals.

1.2.2 Oversight of Program Activities

The Division reviews energy plans and budgets to ensure consistency with the energy efficiency goals, and reports its opinion to the Department of Telecommunications and Energy ("the Department"). The Department determines whether energy efficiency programs are cost-effective according to its cost-effectiveness methodology.[5] The Division also periodically monitors the implementation of energy efficiency plans to ensure progress toward statewide energy efficiency goals.

1.2.3 File Annual Report with the Legislature

The Division reports annually on the extent to which energy markets are meeting the Commonwealth's energy efficiency goals. This report, the second of five that will be submitted between 1998 and 2002, describes progress toward the goals. Specifically, it details the operation of Programs,[6] including the extent to which these programs have enhanced competitive market development for energy efficiency. Finally, the annual reports explain how each year's accomplishments and challenges influenced subsequent plans.

1.3 1999 Energy Efficiency Report Focus

This report summarizes the extent to which 1999 energy markets are meeting statewide energy efficiency goals. It presents a framework of indicators for monitoring annual progress. Specifically, the report assesses 1999 performance against several goals and objectives, compares it to 1998 activities, and discusses future challenges and opportunities for improvement.

The remainder of this annual report is organized as follows:

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[5] The Act directs the Department to define cost-effectiveness and then review electric distribution company (and municipal aggregator) energy efficiency plans to ensure that the programs are cost-effective and utilize competitive procurement processes to the fullest extent practicable. The Department shall serve as the adjudicator when distribution company or municipal aggregator energy efficiency plans are contested by one or more parties, including the Division. In those instances, the Department will decide the cases based on its own rules and policies and compliance with statewide energy efficiency goals, as identified and articulated by the Division.

[6] This report addresses electric utility ratepayer-funded energy efficiency activities, and does not cover energy efficiency activities of municipal light companies or natural gas distribution companies.

Chapter 2 provides background information regarding electricity consumption and energy efficiency in Massachusetts. It also presents statewide energy efficiency goals and supporting objectives, including a description of the process used to develop the goals and objectives.

Chapter 3 addresses the contributions of 1999 Program activities to the overall statewide goal of strengthening the economy and protecting the environment.

Chapter 4 explains the contributions of the 1999 Program activities to cost-effectiveness and customer allocation objectives.

Chapter 5 describes the contributions of energy efficiency activities to the statewide objective of balancing immediate and long-term savings for customers.

Chapter 6 reviews progress toward the objective of developing competitive energy efficiency markets in Massachusetts.

Chapter 7 summarizes insights drawn from the review of 1999 experience, and outlines the Division's plans for assessing the future of ratepayer funded energy efficiency activities beyond 2002.

CHAPTER 2: ELECTRICITY CONSUMPTION AND ENERGY EFFICIENCY IN MASSACHUSETTS

2.1 Massachusetts Electricity Consumption

Total electricity sold to Massachusetts customers in 1999 by investor-owned electric distribution companies[7] was 43,724 million kWh (Table 1). This represents an increase of 4.5 percent over 1998.

Table 1: 1999 Electricity Consumption by Customer Sector and Major End-Uses

Customer Sector	Electricity Consumption (million kWhs)	Percent of Total	Major Customer Sub sectors	Major End-Uses
Residential	14,885	33	Single-family and multi-family homes, and apartment buildings.	Space heating and cooling, water heating, venting, refrigeration, lighting, household appliances.
Commercial	20,899	48	Business, health, educational, and engineering services, retail trade (including food and general merchandise stores), and state government.	Lighting, heating, ventilation, and air conditioning (HVAC) systems, motors and refrigeration.
Industrial	7,665	18	Manufacturing, including industrial machinery and equipment, electronic equipment, instruments, printing and publishing, and fabricated metals.	Lighting, heating, ventilation and air conditioning (HVAC) systems, motors, boilers, air compressors and process equipment.
Other	285	1	Street lighting	Traffic lights and street lamps.
Total	43,724	100		

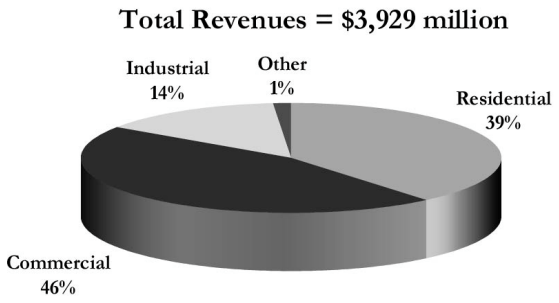
Source: 1999 Massachusetts Electric Distribution Companies FERC Form 1; Division of Energy Resources

Revenue generated by these sales totaled $3.9 billion.[8] Residential, commercial and industrial end-uses accounted for $1.53 billion (39 percent), $1.79 billion (46 percent), and $0.58 billion (14 percent), respectively, as shown in Figure 1 on the following page.

[7] The Act exempts municipal electric companies from mandated energy efficiency funding provisions. Therefore, these figures and all electricity consumption and expenditure data for Massachusetts in this report, are specific to investor-owned electric distribution companies, and do not include municipal electric companies in the state.

[8] Note that these revenues reflect only regulated distribution company total electricity revenues, and do not include generation revenues from competitive retail suppliers selling electricity in Massachusetts in 1999.

Figure 1. 1999 Electric Distribution Company Revenues



Source: 1999 FERC Form 1 revenue data for Massachusetts Electric Distribution Companies

2.2 Barriers to Investing in Energy Efficiency

The Department defines energy efficiency as "the implementation of an action, policy or measure which entails the application of the least amount of energy required to produce a desired or given output and includes demand-side management and energy conservation measures."[9] Improvements in energy efficiency include replacing energy-using equipment, such as lights, motors, air conditioners, and appliances with more efficient electrical equipment. Virtually every energy end-use could benefit from more efficient technology than what is in general or standard use today. Increased energy efficiency is also realized through changes in behavior such as turning off or dimming lights, and raising air conditioning thermostats (or lowering heating thermostats) in unused spaces.

Higher efficiency equipment is often more expensive than standard technology. However, over time the savings achieved through reduced electricity use and longer lasting equipment covers the higher initial purchase cost. The relative difference in initial cost for higher efficient technologies versus standard technologies (e.g., an incandescent bulb compared to a compact fluorescent bulb) is one example of a barrier that customers face when deciding what equipment to install in their building or facility. Other barriers can include limited product availability, lack of knowledge about benefits of higher efficient products, limited incentive for renters to make improvements in efficiency that will benefit mostly the owner, and limited or undesirable design features of higher efficient products. As discussed throughout this report, ratepayer-funded energy efficiency programs assist customers in overcoming these barriers by providing rebates to reduce the incremental costs of the higher efficient equipment, as well as provide important information about the benefits and availability of higher efficient equipment. See Appendix D for further details on common barriers to investing in energy efficiency.

[9] Department of Telecommunications and Energy, Docket 96-100 Definitions

2.3 Historical Rationale for Ratepayer-Funded Programs

Since the late 1980s, electric ratepayer-funded activities have been a core element of the Commonwealth's energy efficiency policies. Programs were initiated as a way to avoid construction of new generating plants in light of the power shortages associated with a booming economy. This strategy, known as *integrated resource management,* required regulated utilities to compare the cost-effectiveness of new generation versus reducing energy consumption through energy efficiency measures. Utilities would then pursue the least-cost alternative. These energy efficiency (or demand-side management (DSM) programs[10], made economic sense for several reasons. First, DSM programs provided *direct* benefits to participants in the form of energy savings, lower bills, and property improvements from higher efficient equipment. Savings also accrued to *all* electric utility customers as *system benefits,* the result of reducing electricity demand over the entire electric system. In effect, they postponed the need to build new power plants. Further, energy efficiency programs helped avoid the addition of transmission lines and transformers. Energy efficiency programs have also included load management programs, which curtail energy use during peak demand periods. Load management programs reduce expensive capacity demand costs that typically would accrue to *all* customers.

In addition to energy savings benefits, energy efficiency programs have provided non-energy and other resource benefits. Non-energy benefits include the creation of employment in the state; increased economic activity stimulated by energy cost savings, increased electric system reliability, and reduced air pollutant emissions. Moreover, because energy efficiency investments help reduce participant's costs, they prevent late payment costs, carrying costs, bad debt expenses, termination, reconnection charges (costs that would otherwise be shared by *all* customers). Energy efficient products also have lower maintenance costs, longer lives, and even increased productivity, compared to standard products.

Finally, other resource benefits include savings from reduced natural gas, oil, and water bills. For example, the investment in an energy efficient clothes washer not only reduces electricity costs, but also reduces water use and, as applicable, the fuel used to heat the hot water.

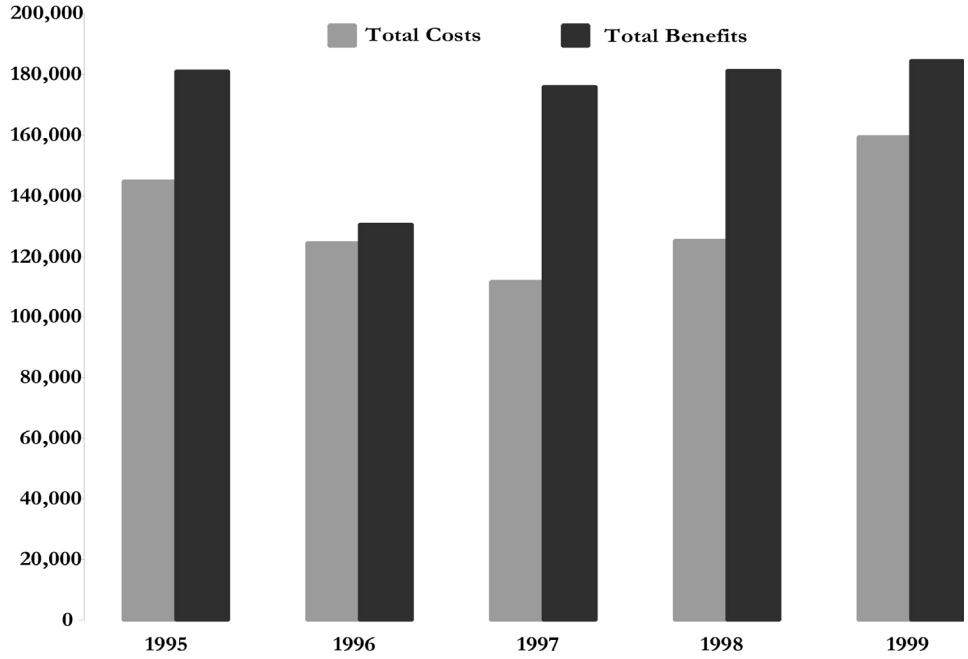
During the 1990s, energy efficiency programs produced economic and environmental benefits that the market, acting alone, would not have produced. For example, between 1995-1999, ratepayer-funded energy efficiency programs saved 18,000 million kWh over the period at a total cost of $665 million (in 1999 dollars).[11] This translates to a cost for conserved electricity of 3.7¢/kWh over the five-year period. During this same period, total economic benefits realized by all customers were $854 million. Comparing total costs of $665 million against benefits of $854

[10] Demand-side management refers to energy efficiency and load management programs funded by electric ratepayers that are implemented to increase the efficiency of energy use by end users or alter energy consumption usage patterns. Throughout this report, the Division uses the term "energy efficiency" instead of DSM, because the majority of program activity currently focuses on end-use energy efficiency as opposed to load management.

[11] This total cost includes program expenditures (funded through the ratepayer energy efficiency charge) as well as participant costs. Participant costs are defined as the investment a customer makes in an energy efficiency project *over and above* what is funded by ratepayer funded energy efficiency programs. Specifically, participants pay directly for a portion of the *incremental cost* of higher efficiency equipment (relative to standard equipment), while the balance of the incremental cost is funded through the energy efficiency programs.

million yields a benefit-cost ratio for these programs of 1.3, where the benefits were a result of avoided energy costs to electric utilities (and thus customers) through reduced demand from energy efficiency program activities. Without these energy efficiency programs, costs associated with higher electrical demand would have been passed on to *all* utility customers through higher electricity rates. Figure 2 depicts the relationship of costs to benefits for customers from 1995-1999. In each year, total benefits exceeded total costs, supporting the finding that the programs have been a cost-effective investment for ratepayers (see Chapter 4.1 for further discussion of cost-effectiveness).

Figure 2: Historical Comparison of Costs & Benefits 1995-1999



Source: 1999 Comparative Statistics of Energy Efficiency Programs
Division of Energy Resources, Dept. of Telecommunications and Energy

2.4 Today's Rationale for Ratepayer-Funded Programs

The rationale for integrated resource management and ratepayer-funded energy efficiency activities has changed with passage of the Act. The resulting divestiture of generating facilities from investor-owned electric utilities moved decisions about constructing new facilities from regulators and regulated utilities to the competitive market. Nonetheless, many of the historical benefits associated with energy efficiency programs are still relevant, even in a restructured electricity market. These benefits, both economic and environmental, include:

- Direct electricity cost savings for all program participants;
- Increased system reliability for *all* customers by reducing energy use during peak demand periods;
- Reduced need for additional transmission lines, distribution wires and transformers, avoiding costs for *all* customers;

- Reduced operating and maintenance costs and increased productivity for businesses;
- Reduced emissions of environmental pollutants, and other resource benefits; and
- Increased incentive to grow local energy efficiency industries.

In addition, an emerging benefit of energy efficiency programs is the impact they can have on wholesale energy market-clearing prices for all customers. In the new competitive market structure, electricity is procured from power plants in order of increasing bids. The market-clearing price paid to all bidding power plant owners is set by the last, highest bid when the demand for electricity is met (e.g., in a particular hour). When energy efficiency programs lower demand for electricity in any given hour, they may displace the need for generation from this last bidder. In that case, the next highest bidder is the one that sets the market-clearing price. By eliminating the need for the last, highest bid, a lower clearing price is paid to all generators. This lower clearing price is passed on to all customers, and is thus a benefit over and above the direct savings that accrue to customers participating in energy efficiency programs. This phenomenon is detailed in Chapter 3.1.2.

2.5 Statewide Energy Efficiency Goals

Given today's rationale for electric ratepayer-funded energy efficiency activities and funding levels put forth in the Act, the Division established statewide energy efficiency goals and objectives as the basis for reporting to the Legislature on statewide energy efficiency activities (Table 2).[12] The overall statewide energy efficiency goal and its supporting objectives largely came from key provisions of the Restructuring Act, as well as an extensive stakeholder input process.

Table 2: Massachusetts Energy Efficiency Goals

OVERALL STATEWIDE ENERGY EFFICIENCY GOAL:
Strengthen the economy and protect the environment by increasing the efficiency of energy use.
ENERGY EFFICIENCY OPERATIONAL GOALS:
1) Reduce the use of electricity cost-effectively
2) Ensure that energy efficiency funds are allocated to low-income customers consistent with the requirements of the Act, and allocated equitably to other customer classes.
ENERGY EFFICIENCY PROGRAMMATIC GOALS:
3) Reduce customer energy costs by balancing short-run and long-run savings from energy efficiency programs.
4) Support the development of competitive markets for energy efficiency products and services

[12] A total of ten goals were developed as part of this stakeholder process in the Spring of 1999. For the purpose of this report, however, the ten goals have been consolidated into one overall goal and four objectives.

The *overall statewide goal* of energy efficiency policies is to strengthen the economy by reducing electricity costs to customers and increasing employment and income in the state, and to protect the environment by reducing harmful air emissions.

Two *operational objectives* for Programs come largely from the Act. First, Programs should be cost-effective (according to a methodology approved by the Department). Second, funding levels for programs serving income eligible households should be the greater of 0.25 mills/kWh or 20 percent of the program funding level for all residential programs. Equitable allocation of Program funds among customer sectors is a related goal of this objective. Equitable allocation means that the distribution of program expenditures to a customer sector is roughly equal to the funds collected from that customer sector. Further, the Division interprets this goal to require that Residential and C&I customer sectors equitably subsidize the Low-income sector, to the extent necessary. These objectives are discussed in Chapter 4.

Programmatic objectives call for Programs to provide immediate as well as long-term electricity cost reductions to customers. In addition, programs should be designed to support the development of competitive markets for energy efficiency products and services. 1999 progress toward these objectives is presented in Chapters 5 and 6.

CHAPTER 3: IMPACT ON THE ECONOMY AND THE ENVIRONMENT

The overall statewide energy efficiency goal is to strengthen the economy and protect the environment. In 1999, Program activities produced direct and indirect economic and environmental benefits for Massachusetts, including increasing disposable income for program participants, creating jobs, and reducing air emissions statewide.

3.1 Overall Goal: To Strengthen the Economy

The overall statewide energy efficiency goal acknowledges the critical role of energy in our state's economy. Conserving electricity strengthens our economy by reducing energy bills. This translates into more money being available for other purposes. This section documents the benefits that accrue to participants from the Programs and those that accrued to all consumers as a result of system benefits, as summarized in Table 3.

Table 3: Summary of Economic Impacts of Program Activities

Electricity Bill Impacts	1998	1999
Energy Savings - Total Participant Annual Energy Savings - Average Life of Energy Efficiency Measures - Total Participant Lifetime Energy Savings - Average Cost for Conserved Energy	$19 million 14 years $265 miilion 3.6 cents/kWh	$20 million 14 years $285 million 4.2 cents/kWh
Demand Savings -Total Participant Annual Demand Savings -Interruptible Service	$4.8 million $3.8 million	$5.1 million $3.5 million
System Impacts		
-Savings to All Customers Due to Lower -Wholesale Clearing Prices	n/a	$6.7 million*
Employment Impacts		
-Net Employment	815 jobs	1,060 jobs
Income from Net Employment	$30 million	$40 million

Source: Division of Energy Resources. See Appendices E-G
* This is not an annual number, but rather represents avoided system costs over a 13-hour period June 7, 1999

3.1.1 Savings to Program Participants

Massachusetts' consumers continued to face relatively high average electricity rates in 1999 compared to other states.[13] Energy efficiency program activities provided opportunities for participants to reduce bills by reducing electricity use, both in the short and long-term. This was

[13] The average total electricity rate for Massachusetts customers in 1999 was 8.9¢ per kWh, compared to the national average of 6.6¢ per kWh. (Source: Energy Information Administration, 1999). Note that these rates do not reflect competitive retail supplier rates.

achieved primarily through energy savings, and for some participants, through demand savings as well.

(a) Electricity Bill Savings Due to Energy (kWh) Savings

Energy savings represent electricity savings available to customers from decreases in kilowatt-hours (kWh) used. Energy savings can be described in two ways: *annual* savings and *lifetime* savings. Annual savings accrue in the year that energy efficiency measures are installed. Lifetime savings reflect the customer savings over the productive life of the energy conservation measures.

Table 4: Energy Savings from Energy Efficiency Programs

Type of Savings	1998 Savings	1999 Savings
Annual	263 million kWh	272 million kWh
Lifetime	3,417 million kWh	3,822 million kWh

Source: Division of Energy Resources, 1999 Compilation of Program Statistics Reported by Program Administrators

Table 4 shows that *annual* energy savings for 1999 Programs were estimated at 272 million kWh[14], the equivalent of annual electricity use for 38,000 households[15]. Long-term energy savings resulting from 1999 equipment installations were estimated to be 3,822 million kWh over an average period of fourteen years. Energy savings in 1999 increased 15 percent over 1998, due to an increase in program spending. Total program expenditures increased by 26 percent, from $99 million to $125 million. The relative changes in savings versus expenditures from 1998 to 1999 are further discussed in Chapter 4.

In order to estimate the average *annual* bill impact resulting from 272 million kWh of energy savings in 1999, the Division analyzed program participation rates, average energy use per participant, rate impacts for each customer sector specific to each distribution company service territory. To begin then, the Division first summarizes program participation rates in 1999, followed by an estimate of annual bill impacts.

(b) Program Participation

In general, total annual program participation[16] increased by 25 percent in 1999, compared to 1998. Participation was highest for the large C&I sector, followed by the Low-income and

[14] All information in this report regarding savings, program expenditures, bill impacts etc. is aggregated across all Massachusetts electric distribution companies. For information specific to a distribution company, contact the Division.

[15] This assumes an average electricity use of 600 kWh per month per household.

[16] For this report, C&I rate classes were aggregated and categorized into small, medium and large sub-sectors. Small C&I includes rate classes with average monthly use of less than or equal to 3,000 kWh/month. Medium C&I includes rate classes with average monthly use greater than 3,000 kWh/month, but less than or equal to 120,000 kWh/month. Large C&I includes rate classes with average monthly use greater than 120,000 kWh/month.

Residential sectors. Small and medium C&I participation was substantially lower, although within the typical 2-3 percent annual participation rate over the past decade. Table 5 provides a summary of annual and cumulative participation rates.

Table 5: 1999 & Cumulative Program Participation

Customer Sector	Total Number of Customers	Number of Participants	Percent Served in 1999	Cumulative Participation Since 1989
Low-Income	489,387	17,867	4	n/a
Residential	1,689,285	163,978	10	60%
Small C&I	145,164	2,215	2	25-35%
Medium C&I	58,494	1,864	3	25-35%
Large C&I	6,156	1,540	25	50-60%
Total/Average	2,392,351	187,464	8	45%

Source: Division of Energy Resources, 1999 Bill Impact Analysis, Compilation of 1999 Program Statistics Reported by Program Administratots

FairHaven Building Participates in ComElectric's Low-income Program

In 1999, Oxford Terrace in Fairhaven, Massachusetts participated in Commonwealth Electric's Income Eligible Energy Efficiency Multi-Family Program. The Fairhaven Housing Authority facility has 108 units with 163 occupants, 108 of which are elderly and 35 handicapped individuals. Under the ComElectric Low-income Program, a number of energy efficiency measures were installed at the Fairhaven building, including efficient lighting and super efficient appliances. Residents and maintenance staff also attended an educational presentation regarding ways to reduce electricity use of major energy consuming equipment (e.g., air conditioners) through modifying lifestyle. The total cost of the project was $93,300. Annual energy savings are estimated at 391,833 kWh, with a lifetime reduction of 4,122,852 kWh. This translates to annual dollar savings of approximately $39,183, and lifetime savings of $412,285.

Residential Sector Participation. Residential participation rates in 1999 were 4 percent for Low-income households and 10 percent for the Residential households. The Low-income participation rate, which is comparatively lower than the Residential rate, suggests a need for more aggressive outreach to this customer sector (defined as households that are at or below 175 percent of the Federal Poverty Level).[17] Participation in 1999 Low-income programs was

[17] The 1999 Total Number of Low-income Customers was derived using the following formula: 1998-99 Low-income eligible households in Massachusetts at 175 percent of the Federal Poverty Level (FPL) (from Massachusetts Institute for Social and Economic Research) minus 13 percent of that population in municipal utilities' territories, multiplied by the 1990 Census percentage of the Low-income eligible households at 175 percent of the FPL for each electric distribution company. This same formula was used to define the Residential Discount Rate Eligible (RDRE) households in the Division's 1999 Market Monitor Report.

primarily by Residential Discount Rate households and tenants living in public housing authority buildings. As discussed in the Division's 1999 Market Monitor report, the Division plans to work closely with the Low-income Energy Affordability Network (LEAN) and the Program Administrators (i.e., distribution companies) to identify ways to increase outreach to low-income households.

The Residential participation rate of 10 percent is higher than the average annual rate for the past ten years (1989-1999). This is largely due to more households participating in several programs during the year, such as the Energy Conservation Services audit program, as well as the *Star Lights* or *TumbleWash* rebate programs. Consequently, some of these customers may have been counted more than once. The Division plans to further analyze program data to determine the extent of "repeat" participation in these residential programs.

Despite lower funding levels in 1999, the average participation rate for all residential customers was similar to earlier years. Future efforts should increase participation for residential customers, including the redesign of the Energy Conservation Services Program and low-income household outreach efforts.

C&I Customer Participation. Twenty-five percent of Large C&I customers participated in the Programs in 1999. The largest energy users reaped substantial benefits from this participation. However, many were also "repeat" customers. For example, in some cases, roughly 22 percent of Large C&I customers participated in more than one program in 1998 and 1999 combined.[18] The Division plans to work with Program Administrators and survey Large C&I customers to better understand the extent of repeat participation in the energy efficiency programs.

Harvard University Installs Efficient and Safe Torchiere Lamps in Dormitories

In July 1999, Harvard University applied to Cambridge Electric's C&I New Construction program. The project incorporated 6,740 fluorescent torchiere lamps in dormitories and other locations. Approximately 1,500 were installed in Phase 1 (1999) and the balance in Phase 2 (2000). Harvard received $15,000 in rebates for Phase 1 of the project, while contributing $89,160. These installations will generate savings of 420,000 kWh per year, or $30,000 annually, and $294,000 over the lifetime of the measures. Phase 2 will add an additional 1,600,000 kWh in annual energy savings, valued at $112,000 per year, and over $1 million over the life of the lamps. This project also provides increased safety from the lighting.

Small C&I Program Offered by Fitchburg Gas and Electric Company

Can Am Machinery of Fitchburg participated in Fitchburg Gas and Electric Company's Small C&I program in 1999. The lighting retrofit project included installing metal halide high bay fixtures in the customer's warehouse. Can Am Machinery received $2,475 in rebates and contributed $1,330 towards the project. Annual energy savings are estimated at 11,364 kWh, translating to $1,225 in reduced energy costs.

Participation rates for the Medium and Small C&I sectors were significantly lower (at 3 and 2 percent, respectively) relative to the Large C&I sector. These lower participation rates can be explained, in part, by the investment barriers for energy efficiency, including a lack of management resources and information, for these sectors. As such, the costs to reach and serve these customers (in terms of cost per kWh of savings) is greater, resulting in less cost-effectiveness, compared to Large C&I participants. However, the 1999

[18] Massachusetts Electric Company, 1999.

Shaw's Supermarket Installs Energy Monitoring System

Shaw's Supermarket implemented an aggressive energy efficiency program throughout New England, including retrofitting seven stores in the Boston Edison service territory. The cornerstone of the project was an energy monitoring system to continuously monitor store electrical loads. The "Smart Station" monitoring and reporting systems included re-commissioning store refrigeration, heating, ventilation and air conditioning (HVAC) systems, and lighting systems. The total project cost was $144,000, with the customer receiving $47,000 in rebates. Customer benefits include annual energy savings of 598,400 kWh, approximately $48,650 in annual electricity cost reductions. Over the lifetime of the measures and systems, Shaw's Supermarkets will save almost 9 million kWh, and an estimated $729,735.

Participation levels for Medium and Small C&I customers are consistent with historical rates. Further, unlike Large C&I participation, which includes many repeat customers, Medium and Small C&I customers do not typically participate in programs more than once. in programs more than once.

(c) Annual Electricity Bill Savings

The Division estimated average bill impacts (from energy savings only) for participating customers based on rate class tariff data and participation levels. Table 6 summarizes the following key findings:

- Total annual bill reductions for all participating customers from program savings
- Average annual bill savings *per participant*
- Average annual bill *reduction* per participant
- Corresponding average annual bill reduction as a percent of the average participant's annual electricity bill

Low-income Customer Benefits from Appliance Management Program

In 1999, Mr. Roger Hills of West Newbury, MA participated in the Massachusetts Electric Appliance Management Program (AMP), a residential appliance efficiency program for low-income customers delivered in cooperation with Community Weatherization Assistance Agencies. The Program provides personalized information on customer electricity usage and installation of energy savings measures. In addition to the in-home education provided, an energy efficient replacement refrigerator was installed. The customer also received compact fluorescent light bulbs and a refrigerator coil brush. Mr. Hills received $964 in services and equipment. Estimated annual energy savings are 1,760 kWh, resulting in approximately $144 in annual cost savings. Over the lifetime of the measures installed, there will be 28,000 kWh in energy savings and $2,300 in electricity cost savings.

Program participants saved over $20 million in direct electricity costs in 1999 (approximately between 3 and 10 percent of the average annual electricity bill). Low-income customers received the highest savings (10 percent).[19] The Small C&I sector accrued the next highest percentage bill reductions (7 percent). These potentially dramatic savings, combined with the low participation rates, suggest that there is a great deal to be saved in the Small C&I sector, although targeting this customer sector is not

[19] The Division's estimates of average annual bill reduction and average annual bill for the Low-income sector are based on 1999 Residential Discount Rate data and the total Low-income program savings. While the program energy savings from Low-income public housing buildings are reflected in the Division's estimated dollar savings, it should be noted that these savings do not necessarily accrue directly to Low-income customers, but rather to the owner of the building, who typically pays a commercial rate.

typically as cost-effective as larger C&I sectors given the difficulty of marketing to these customers.

Table 6: 1999 Average Bill Impacts from Energy Savings

Customer Class	Total Annual Bill Reductions for Participants	Avg. Annual Bill Savings per Participant	Avg. Annual Bill Reduction per Participant	Avg. Reduction as a Percent of Total Avg. Annual Bill
Low-Income	$837,387	$490	$47	10%
Residential	$4,878,359	$691	$30	4%
Small C&I	$1,764,520	$11,456	$797	7%
Medium C&I	$2,030,042	$35,479	$1,089	3%
Large C&I	$10,871,997	$265,509	$7,060	3%
Total/Average	$20,382,306	$3,270	$109	3%

Source: Division of Energy Resources, Bill Impact Analysis. See Appendix E

Medium and Large C&I participants both reduced their average annual bills by an average of 3 percent, although it is important to note that for these customers, the range of savings across energy efficiency projects can be considerable (e.g., as high as 10 percent of annual electricity costs) depending on the scope of the project, as illustrated in the case studies throughout this section.

Osborn Country Store Improves Efficiency of Cooler System

Osborn Country Store participated in Commonwealth Electric's Small C&I Program in 1999. Cooler economizers and controls were installed to regulate thermostat zones for a walk-in cooler, evaporator fan, electric door heaters, and to reduce compressor run time. ComElectric paid 80 percent of the total project cost ($8,893), while the customer paid the 20 percent balance. Estimated annual savings were 36,464 kWh, or $2,917 in reduced electricity costs. Over the lifetime of the installed controls, savings are estimated to be almost 550,000 kWh, with total savings of $43,756 to Osborn Country Store.

(d) Long-term Electricity Bill Savings

Table 6 presents only the *annual* bill impacts due to energy savings from the 1999 Programs. Over the productive *lifetime* that the equipment remains in place – an average of 14 years – total savings are projected to grow to approximately $285 million for participating customers.

Plastics Manufacturer Improves Efficiency of Its Operations

PGM Plastics of Fitchburg participated in the Comprehensive Efficiency Program in 1999. The project included installation of premium efficiency rooftop air conditioning units, which improved molding machine clamp time by over 20 percent. This project helped to reduce the customer's electricity costs and helped to increase productivity. PGM received $25,500 in rebates through Fitchburg Gas and Electric Company's ratepayer-funded program and contributed an equivalent amount. Annual energy savings to PGM Plastics were 158,125 kWh, or approximately $10,600 in electricity cost reductions.

Another way to quantify the impact of energy savings from 1999 Program activities is to compare program costs and energy saved over time (i.e., the cost of conserved energy), to the projected average retail electricity cost over roughly the same period. A total investment of $159 million was made in 1999 for higher efficient equipment through the Programs.[20] These investments are projected to produce lifetime energy savings of 3,822 million kWh, translating to an average cost for conserved energy of 4.2¢/kWh[21] – almost 60 percent less expensive than the projected average retail price (10.2¢/kWh) over the same period.[22]

Paper Mill Improves the Efficiency of Its Air Compressors

Texon International, a paper mill, located in Russell, MA approached Western Massachusetts Electric Company (WMECo) with their production needs for compressed air. Two existing compressors were not providing adequate air capacity. Texon felt that a new larger compressor was needed, and asked if this would qualify for an incentive through WMECo's energy efficiency program. WMECo commissioned an analysis by a consulting engineer, which identified two major areas of energy loss: leaks in distribution air piping, and "artificial demand," which caused plant air pressure to be run at a higher pressure than needed. Seventy-seven air leaks were identified and repaired. A pressure regulator and 1,500 gallon storage receiver was installed under WMECo's Operation and Maintenance Program. After this optimization, plant air pressure was reduced from 92 pounds per square inch (psig) to 80 psig. These efficiency improvements not only eliminated the need for the proposed new larger compressor, but Texon is now able to operate the majority of the time using only one compressor. The customer received a rebate of $28,650 for the improvement. They also benefited from information concerning how to use compressed air efficiently. The project resulted in estimated total annual savings of 200,000 kWh, and 1,576,600 kWh over the lifetime of the project. The project also eliminated the need to purchase a new, unnecessary compressor, and extended the interval of major maintenance on the existing compressors by alternating the use of each unit monthly.

[20] This $159 million includes 1999 energy efficiency expenditures funded through the mandated ratepayer energy efficiency charge of $125 million, plus participant costs of $34 million.

[21] For 1999, the average cost of conserved energy is calculated as the total ratepayer funded energy efficiency expenditures plus participant costs ($125 million and $34 million, respectively) divided by projected lifetime energy savings (3,822 million kWh) due to energy efficiency measures installed in 1999. Compared to 1998 (see Table 3), this value is higher for two reasons. First, the 1998 value of 3.6¢/kWh was slightly underestimated due to understated participant costs in 1998 as reported by the Program Administrators. Second, the 4.2¢/kWh reflects accelerated contractual payments (i.e., payments that otherwise would have been made beyond year 2002 were brought forward to 1999-2002) for Integrated Resource Management programs, while associated program kWh savings remained unchanged. The acceleration of these contractual payments was agreed to by key non-utility parties, and approved by the Department, in order to ensure that ratepayer energy efficiency funds were not committed beyond the 2002 time period mandated by the Act.

[22] Source: The Division of Energy Resources - Energy 2020 Model. This average retail electricity price (in 1999$) reflects prices over the average productive life of the energy efficiency measures installed in 1999, and includes all components of electricity price (e.g., generation, transmission, distribution and customer charges).

(e) Electricity Bill Savings Due to Demand (KW) Reductions

Demand savings represent the impact that the energy efficiency programs have on reducing demand (in kilowatts or KW) on the electricity system during very high or "peak" periods, when electricity is more expensive. Customers that participated in the Programs, and that had a demand charge component on their electricity bill, saved money directly by reducing their electricity demand.

In 1999, Programs resulted in 115 MW of demand savings[23], representing 1.3 percent of the distribution companies combined summer coincident peak demand of 9,063 MW. Roughly half of these savings was attributable to load management programs, primarily C&I interruptible service programs in which large C&I customers agreed to reduce their electricity load when called upon by their distribution company during capacity shortage or emergency situations. In 1999, participating C&I customers received $3.8 million in interruptible service credits. In order to maximize the benefits of these interruptible credits, distribution companies encouraged participating customers to apply the credit payments to investments in energy efficiency at the customers' facility.

The Cooperative Interruptible Service (CIS) Program

Massachusetts Electric offered a monthly credit to C&I customers in exchange for their agreement to reduce electricity load when called upon by the distribution company. Two notification periods were available: one-hour notice and previous business day notice. Bonuses and penalties to the basic credit were used to enforce customer performance. In 1999, 59 customers participated in the CIS program, and were credited over $3.5 million for providing a total of 38,449 kW of electricity demand available for reduction. Actual interruptions occurred between 5 and 9 days during the year, depending on whether participating customers were 1-hour notice or one-business day notice customers. This program is currently closed to new customers and ends on January 1, 2001.

Interruptible credit programs play an important role in reducing demand on the electric system. The Division, however, with other key stakeholders, have directed Program Administrators that offer these programs to discontinue funding them through the ratepayer-funded energy efficiency charge. Rather, the Division views the development of a market-based demand-bidding program at the New England Independent System Operator (NE-ISO) as a more appropriate venue for alleviating peak demand on the system. Further, to the extent distribution companies determine there is a continued need to reduce demand through interruptible credit type programs (e.g., in order to help maintain service reliability for generation, transmission and distribution), the Division believes these programs should be funded through sources other than the energy efficiency charge.

The balance of demand savings were provided through end-use savings (during the distribution company's coincident peak hours) to both residential and C&I customers. The majority of these, or approximately 46 MW, provided direct savings for certain participating customers – specifically those that have a demand charge component on their electricity bill, primarily medium and large C&I customers. The Division estimates these savings to be roughly $5 million

[23] These KW savings are based on combined company summer coincident peak demand savings reported by the Program Administrators. Annual winter KW savings for all distribution companies were 103 MW.

annually for participating customers with demand charges.[24] These demand savings will persist over the productive life of the energy efficiency measures installed in 1999, thus benefiting the participants over the long term. See Appendix E for further details.

3.1.2 Electric System Benefits

In addition to the direct economic benefits program participants received, the 1999 Programs provided system-wide benefits to all customers by:

- Reducing wholesale energy clearing prices
- Enhancing generating system reliability during peak usage periods
- Enhancing reliability of local transmission and distribution networks

(a) Reducing Wholesale Energy Clearing Prices

Historically, energy efficiency programs have postponed the need to build new generation plants by reducing the growth of electricity demand. Today, these programs provide slightly different benefits to the New England electricity system, a consequence of the new competitive wholesale electricity market. Demand reductions help avoid costs of generating electricity *on the margin*, or during *peak* hours when electricity is most expensive.[25] With the new market and transparent prices, it is possible to estimate the value of demand reductions in terms of reducing market-clearing prices. Since the market-clearing price for electricity is a function of overall system supply and demand, individual customer demand reductions help reduce this price, thus providing monetary benefits to all customers in the region.

Procurement of Electricity in the Competitive Wholesale Market in New England

Under the current competitive market structure at ISO-NE, electricity from power plants is procured in order of increasing bids. The market-clearing price paid to all bidding power plant owners that are dispatched is set by the last, highest bid when the demand for electricity is met (e.g., in a particular hour). When energy efficiency programs lower demand for electricity in any given hour, they may displace the need for generation from this last bidder. In that case, the next highest bidder is the one that sets the market-clearing price. By eliminating the need for the last, highest bid, a lower clearing price is paid to all generators. This lower clearing price accrues to all customers, and is thus a benefit over and above the direct savings that accrue to those customers who participate in the energy efficiency programs.

The situation that occurred in New England on June 7, 1999 illustrates this phenomenon. June 7th was an unusually hot day, and the electricity system in New England was not fully prepared to meet the unexpected high demand for electricity during the peak hours (10am to 10pm). During this 13-hour period, New England's electricity demand reached an average peak of 20,076 MW and market prices reached an average of $388 per MW. Energy efficiency program related demand reductions during the 13 hours[26] reduced the average peak demand by 115 MW. Absent

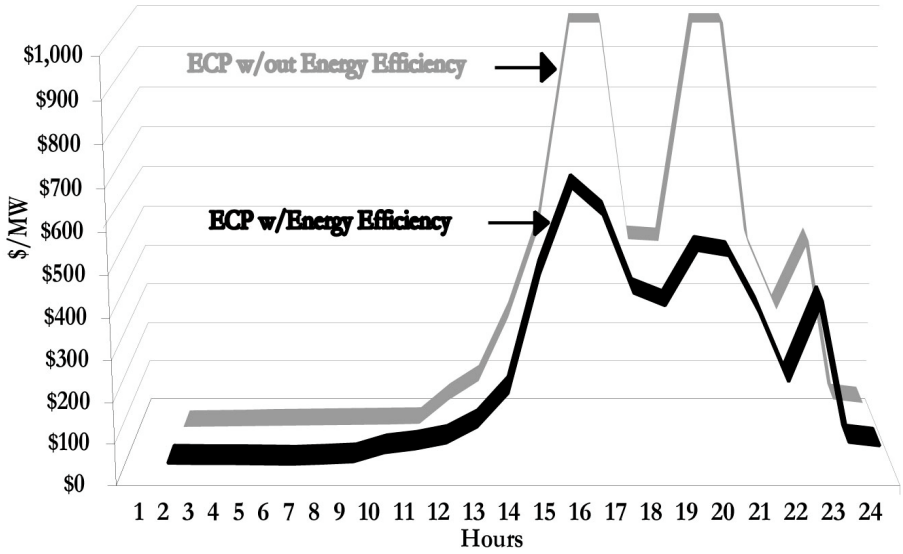
[24] This compares to demand savings in 1998 of $4.8 million (see Table 3). Note that the demand savings in 1998 were incorrectly reported in the 1998 Energy Efficiency Report to the Legislature. The revised value in Table 3 reflects a full year of demand savings to C&I customers, as opposed to only one month that was reported in the 1998 Report.

[25] Ferguson, Rich. *Restructuring and Environmental Stewardship.* The Electricity Journal, July 1999.

[26] For simplicity, this analysis assumes that the distribution companies' combined summer coincident peak demand reductions of 115 MW occurred in these hours on June 7, 1999.

these demand reductions, the average peak demand may have been higher, resulting in higher bid prices setting the market-clearing price in each hour. Specifically, the average market-clearing price over the 13-hour period might have been $550 per MW, or 40 percent higher than the average market clearing price without the 115 MW demand savings from Programs (Figure 3). The Division estimates that this impact may have avoided roughly $6.7 million in *additional* costs to the system (i.e., to all customers) over the 13-hr period analyzed.[27]

Figure 3: Potential Impact of Demand Reductions on Wholesale Energy Clearing Prices (ECP) on June 7, 1999



Clearly, it is important to note that although day-ahead price bids (as reported by ISO-NE) should represent what prices would have been given higher demand, it is impossible to predict precise prices, given the nature of day-ahead bids (e.g., they can change on day-of bids or the ISO can take certain measures to help reduce prices). Nonetheless, the June 9, 1999 example represents only a magnitude of savings to *all* customers given the following considerations:

1. The estimated $6.7 million savings represent system benefits on *one day only*. The magnitude of savings for all customers would be significantly higher over a longer time period, such as peak hours for the whole summer, or if the value of demand reductions were averaged over a year.

2. The Division's analysis focused only on Massachusetts. It did not include the impacts of demand reductions from ratepayer-funded energy efficiency activities in other New England states (e.g., CT, RI, NH, VT).

[27] The Division's analysis (including load data, bid schedules, and market clearing prices) is based upon data reported by ISO-NE. Note that the $6.7 million in savings reflects savings to the spot market load (i.e., what was traded in the spot market in each hour), as opposed to total load (most of which is traded through bilateral contracts). The average spot market load over the 13-hour period was 2,988 MW. See Appendix F for details.

3. In addition to the short-term system savings identified above, reducing market clearing energy prices benefits all customers over the *long-term* by influencing future market clearing prices as well as future bilateral contract prices.

4. Finally, by reducing energy use during peak periods, energy efficiency efforts help displace the need to run generation plants at the margin, which tend to be higher polluting plants. While the Division does not estimate the monetary value of reduced emissions, the Division recognizes this as a societal benefit. A discussion of environmental impacts is discussed further in Section B below.

(b) Increasing System Reliability

By reducing demand, Programs contribute to system reliability in terms of supply adequacy within a particular area or region. Their contribution depends on the technologies targeted. Lighting and refrigeration, for example, reduces base load, while air conditioners help reduce summer time peak load. All energy efficiency measures, however, help maintain adequate margins of generation supply, and can help deter brownouts and blackouts.

(c) Increasing Reliability of Local Transmission and Distribution Networks

A third system benefit of energy efficiency programs is enhanced reliability of local transmission and distribution networks. For example, the outages in New York and Chicago during the summer of 1999 were caused by failures and weaknesses in the distribution system, not generation supply inadequacy. This is especially important in Massachusetts where there is constrained transmission into areas in and around Boston and the Cape and Islands. By reducing load and demand on the power distribution network, the Programs decrease the (costly) likelihood of failures. Over the longer term, energy efficiency programs can postpone the need for additional transmission lines and transformers, thus delaying costs paid by all customers.

In conclusion, the Division believes there are opportunities in Massachusetts to reduce summer peak demand through energy efficiency programs that would provide benefits to all customers on the system in the three key areas discussed above. This can be done by a) focusing on installing higher efficiency air conditioning and chiller units prior to summer for residential and C&I customers; b) promoting higher efficiency standards for air conditioning equipment; and c) targeting C&I recommissioning opportunities. The Division plans to address these opportunities during 2001 with Program Administrators and key stakeholders.

3.1.3 Economic Development Impacts

Economic development impacts of 1999 Programs are visible in several forms: job creation in the energy efficiency industry and other industries in Massachusetts; and direct savings to C&I customers for capital reinvestment and/or competitive improvements. Several distribution companies also supported development projects in qualified economic development areas. Projects received funding for most or all of the costs of improving facility efficiency.

Energy Efficiency Program Targeted Economic Development Project

Wrentham Development Center, a state-operated rehabilitation center for mentally handicapped people, in Wrentham, MA, needed to replace old, unreliable and inefficient motors and poor lighting systems. The Center, given state fiscal constraints, worked with Massachusetts Electric to improve operations. The customer received $253,250 in rebates through the Energy Initiative retrofit program, which allowed the Center to replace its inefficient motors and lighting with premium efficient motors, and T-8 lamps with electronic ballasts and compact fluorescent fixtures. As a result of these investments, the Center is able to save 1,287,000 kWh annually, or approximately $103,000 in reduced costs. Over the life of the installed efficient measures, the savings to the customer are considerably more.

The Division examined employment impacts using the Regional Economic Model (REMI)[28]. The Division estimates that 1999 Program expenditures (plus associated participant costs) added 1,060 new jobs to the Massachusetts economy in 1999. The majority of jobs were created in the services industry (56 percent), following by retail trade (10 percent) and manufacturing (10 percent), construction (8 percent), and wholesale trade (7 percent). These new jobs added $72 million to the gross regional state product, including $40 million in disposable income in 1999 alone. The 1,060 jobs created in 1999 will persist, but at a decreasing rate, over more than a decade.

Pittsfield Plastics Stays in Massachusetts

Pittsfield Plastics, located in Pittsfield, MA manufactures plastic injected molded products. The owner originally contacted Western Massachusetts Electric Company (WMECo) complaining that high electricity costs were forcing him to consider relocating to the South. WMECo evaluated opportunities to reduce energy use, and analyzed the installation of a variable frequency drive (VFD) on an existing plastic injection molding machine. Through WMECo's Custom Services Program, a VFD was installed, resulting in estimated savings of 82,700 kWh annually and 1,240,500 kWh over the lifetime of the VFD. The total rebate paid to Pittsfield Plastics was $8,300, representing half the total project cost. Subsequently, Pittsfield Plastics also participated in WMECo's conservation programs and installed an additional VFD, compressed air optimization and a new compressed air dryer. The owner recently recommitted to staying in Massachusetts, and is breaking ground on a new addition to the Pittsfield facility. WMECo is planning to work further with Pittsfield Plastics to install high efficient lighting at the facility.

Summary: Overall Statewide Goal – Strengthen the Economy

The Division concludes that 1999 Programs produced net gains for participants and the Commonwealth. Customers reduced their annual bills, and will continue to benefit over the lifetime of the conservation measures installed in their facility or home. This, in effect, increased customers' discretionary spending, with corresponding benefits to the state economy. Moreover, analysis of benefits to the entire New England electricity system demonstrate that energy efficiency activities can play an important role in helping to reduce market clearing prices and increase system reliability. The Division will work closely with Program Administrators and key stakeholders to identify further opportunities for bringing these types of benefits to all customers through Program activities.

[28] See description of model and assumptions in Appendix G.

3.2 Overall Goal: To Protect the Environment

The overall statewide energy efficiency goal acknowledges the detrimental environmental effects from electricity generation. By reducing electricity consumption, energy efficiency programs can help reduce emissions caused by fossil fuel combustion used to generate electricity. In 1999, about 58 percent of all electricity generation in New England came from fossil-fueled generation plants. The environmental consequences of emissions from such plants include acid rain, ground-level ozone (smog), and climate change, as described in Appendix H.

3.2.1 1999 Emission Reduction Impacts

Table 7 provides a summary of the impact that 1999 Programs had on reducing annual emissions of the primary pollutants: sulfur dioxide (SO_2), nitrogen oxides (NO_x), and carbon dioxide (CO_2). These emissions reductions were estimated based on the 272 million kWh of energy saved in 1999 due to 1999 program activities.

Table 7: Impact of 1999 Programs on Reducing Air Emissions in New England

Pollutant	Environmental/Health Impacts	Avoided Emissions (tons) per year
Nitrogen Oxides (NO_X)	Smog, acid rain, lung damage, respiratory system illnesses	453
Sulfur Dioxide (SO_2)	Acid rain, damage to trees and lakes, lung damage, respiratory system illnesses	770
Carbon Dioxide (CO_2)	Climate change, abnormal weather patterns, rise in sea level, alter forests, crop yield and water supplies	144,940

Source: Division of Energy Resources-Energy 2020 Model Analysis.
See Appendix I

To provide more comprehensible reference points for the tons of avoided emissions listed in Table 7, the Division estimates the following:

- Emitting 453 fewer tons of NO_x from power plants is the equivalent of removing more than 34,000 automobiles from New England roads of in 1999.[29]
- Emitting 770 fewer tons of SO_2 (if all were from coal burning power plants) is the equivalent of burning 55,000 fewer tons of coal in New England.[30]

- Emitting 144,940 fewer tons of CO_2 comparable to removing about 29,000 automobiles and other light vehicles from the roads.[31]

3.2.2 Long-term Emission Reduction Impacts

It is important to note that emission reductions in Table 7 reflect reductions for 1999 *only*. Not only do Massachusetts' residents continue to reap environmental and health benefits from efficiency measures installed *in prior years,*[32] but they will continue to reap certain benefits from 1999 programs over the lifetime of the measures installed in that year due to lifetime energy savings of over 3,800 million kWh. The Division did not include an estimate of lifetime or cumulative benefits in this report due to recent changes in the modeling method used by the Division. However, in next year's report, the Division plans to expand its analysis to incorporate a range of factors into its modeling to simulate the long-term impacts of energy efficiency on reducing air emissions. These factors may include:

- Uncertainty about long-term fuel prices;
- Stricter state and federal standards for electricity generation;
- Changes in the portfolio of New England power plants; and
- Energy efficiency impacts on demand and the dispatch of power plants.

[29] The NO_x equivalence is based on 1.0 grams of NOx emitted per mile for light duty vehicles (automobiles—not SUVs, vans, or pick-up trucks) and 12,000 miles per year per average vehicle (personal communication from the MA Department of Environmental Protection [DEP], January 2000).
[30] The SO_2 equivalence is based on 71.2 tons of coal per ton of SO_2, based on 1998 data from the Energy Information Agency's 1998 *Electric Power Annual*, Vol. 1, Tables 14 (8,136 thousand tons of coal burned by New England power plants) at http://www.eia.doe.gov/cneaf/electricity/epav1/ta14p1.html, and the EPA's "Emissions Scorecard 1998," Table B3 (114,275 tons of SO_2 emitted from New England coal burning power plants) at http://www.epa.gov/airmarkets/emissions/score98/tavble_b3.xls
[31] The CO_2 equivalence is based on 4.9767 tons of CO_2 emitted per vehicle per year, based on 1998 Massachusetts gasoline consumption data (per the MA DEP), the total number of gasoline vehicles registered in Massachusetts in 1998 (per the MA Department of Motor Vehicles via the MA DEP), and US EPA methodology.
[32] Ratepayer-funded energy efficiency programs began in 1989. Impacts from 1989 energy efficiency installations, and subsequent years, continue to have impact on emission reductions during the lifetime of the measures (e.g., up to year 2004 for 1989 program installations), given an estimated average lifetime of 14 years.

Summary: Overall Statewide Goal – Protect the Environment

Currently, there are many strategies – both regulatory and market-based – underway to combat the air quality effects of electricity generation. These include federal (Clean Air Act), regional (Northeast States Coordinated Air Use Management), and state regulatory efforts. Market-based programs include tradable allowances for SO_2 and NO_X, and voluntary programs promoting energy efficiency and renewable energy. Energy efficiency programs play an important and complementary role in this larger context of environmental protection by improving air quality in the state and region.

CHAPTER 4: PROGRAM COST-EFFECTIVENESS AND ALLOCATION OF FUNDS

4.1 Program Cost-effectiveness Objective

The Act requires that ratepayer-funded energy efficiency programs meet cost-effectiveness criteria defined by the Department of Telecommunications and Energy (the Department). The Department's required methodology compares benefits and costs of each program and calculates a benefit-cost ratio. A program benefit-cost ratio of 1.0 or higher is considered cost-effective under the methodology. The process for developing, reviewing and approving program cost-effectiveness is described in Appendix J.

4.1.1 Cost-effectiveness Methodologies

Prior to year 2000, Program Administrators used several tests to evaluate programs. These methodologies included the *electric system test* (or *utility test*), the *total resource cost test,* and the *societal test.* The tests differ in how they define benefits and costs and from which perspective (i.e., that of the distribution company, and/or the participating customer, and/or society as a whole) one views the benefits and costs, as described in the textbox below

Overview of Key Cost-effectiveness Test Methodologies

Electric System Test - The Electric System Test (EST) considers benefits and costs to the electric system as a result of the energy efficiency programs, and is used to ensure that electric ratepayers receive net benefits from the energy efficiency programs they fund. Benefits include the value of avoided wholesale electricity costs, as well as avoided transmission and distribution costs to the distribution company that otherwise would be passed on to ratepayers. The denominator of the cost-effectiveness ratio using the EST is simply annual energy efficiency program costs funded by ratepayers, and does not include participant costs.

Total Resource Cost Test – The Total Resource Cost Test (TRC) considers a broader set of benefits and costs than the Electric System Test, including the direct benefits and costs to the participating customers. Specifically, benefits extend to quantifiable benefits that accrue to participating customer such as the impact that energy efficiency equipment has on avoiding other energy costs as well as non-energy costs (e.g., reduced gas bills, increased worker productivity, decreased O&M costs). Costs extent beyond just program costs paid by ratepayer energy efficiency funds, and include the direct investment made by the customers that participate in the programs. For example, while a program may cover 75% of the incremental cost of installing more efficient equipment over standard equipment, a customer pays the balance of this incremental cost, known as the "participant cost." The TRC test is basically the Societal Test without externalities (see below), and is the test required by the Department in its 98-100 Order.

Societal Test – The Societal Cost Test is structurally similar to the TRC test, yet it goes beyond the TRC test in that it attempts to quantify the change in total resource costs to society as a whole rather than to only the utility service territory (the distribution company and its ratepayers). In taking society's perspective, the Societal Cost Test utilizes essentially the same input variables as the TRC test, but they are defined with a broader societal point of view. Examples of societal benefits from avoided electric generation can include reduced emissions of sulfur dioxide, nitrous oxide and particulates from power plants.

In 1999, like in 1998, comparable data provided by Program Administrators were sufficient to support only the electric system test. As such, the Division's analysis presents cost-effectiveness results from the electric system perspective. However, it is critical to note that the Department developed new cost-effectiveness guidelines in 1999, which will apply to program activities in the years 2000-2002. These guidelines require use of a total resource cost test, and that benefits

be quantifiable and based on data relevant to Massachusetts. The effect of the new cost-effectiveness guidelines is to broaden the range of quantifiable benefits used to assess the cost-effectiveness of energy efficiency programs in coming years (2000-2002). The Division will expand its reporting on cost-effectiveness to the total resource cost test beginning in 2000.

4.1.2 1999 Program Cost-effectiveness

Overall, statewide benefits in 1999 outweighed total costs to ratepayers by a factor of 1.6, compared to a 1998 factor of 1.7. The Division reports herein on overall cost-effectiveness for three key customer sector programs: Low-income, Residential, and C&I.

(a) Low-income Programs

The cost-effectiveness of Low-income programs was 0.9, a 35 percent increase over the benefit-cost ratio reported in 1998.[33] Despite this increase, many benefits associated with providing Low-income customers with energy efficiency products and services were not captured using the electric system test methodology in either 1998 or 1999, but are anticipated to be accounted for in the future as a result of the Department's 98-100 Order. These benefits include reduced costs associated with arrearages and late payments, bad debt write-offs, credit and collection activities, termination and reconnection, negotiation of payment plans, and regulatory expenses. Benefits also accrue directly to the low-income households as a result of installing more efficient equipment in their homes, including reduced energy bills, improvements in comfort and health, and reduced evictions and homelessness.[34] If these benefits had been included in the 1999 cost-effectiveness calculation, it is likely that the benefits of the low-income programs would have outweighed the costs by a factor of more than 1.0.

(b) Residential Programs

The Residential programs had a benefit-cost ratio of 1.1 in 1999, a slight increase in cost-effectiveness compared to 1998. The Division expects this cost-effectiveness ratio to increase in the future as a result of three key developments. First, the Department's 98-100 Order allows benefits for certain types of energy efficiency programs (e.g., regional market transformation programs) to include savings accrued to customers *after* the program ends, in addition to the savings accrued while the program is active. This impact, known as "market effect", is the key objective of the regional market transformation programs, and should be considered a benefit of the programs. Assuming that market effects are increasingly quantifiable, the overall cost-effectiveness of the residential programs will likely increase in the next few years.

A second component of the 98-100 Order allows for the inclusion of "other resource" benefits, such as the value of saving water and gas from efficient clothes washing machines. Inclusion of these benefits will also increase the value of certain residential programs. Third, redesign of the

[33] The benefit-cost ratios reported in the 1998 Report have been updated to reflect revised or corrected information. The revised benefit-cost ratios for 1998 programs are as follows: 0.4 for the Low-income sector, 1.0 for the Residential (non-L/I) sector, and 2.2 for the C&I sector.
[34] Department of Telecommunications and Energy, Docket 98-100 Order, Section IV.D.

statewide Residential Conservation Services Audit Program will facilitate greater implementation of energy efficiency measures, making the program more cost-effective with a ratio of at least 1.0, compared to current levels of between 0.5 and 0.7.

(c) Commercial & Industrial Programs

C&I programs were almost twice as cost-effective as residential programs, primarily because C&I customers can take advantage of economies of scale. Their costs to purchase and install energy efficiency measures are less per unit for most C&I projects. C&I customers also use electricity for a greater proportion of each day compared to residential customers. Therefore, C&I customers see greater savings from more frequent use of their energy conservation measures.

C&I programs generated a benefit-cost ratio of 1.9 in 1999, a 14 percent decrease from 1998. The primary reason for this decrease was due to less activity in load shedding programs and program variations.[35] Similar to the residential programs, the Division anticipates that cost-effectiveness of C&I programs will increase in the future, the result of the Department's 98-100 Order. Certain economic benefits associated with lowering O&M costs and increasing worker productivity will be allowed under the Department's new cost-effectiveness methodology. Further, environmental benefits associated with the reduction or avoidance of future compliance costs will also be permitted.

It is important to note that while the Department's 1999 cost-effectiveness methodology measured the value of programs from the perspective of "electric system benefits," C&I customers typically make energy efficiency investment decisions based on specific payback periods and other investment criteria. The Division will be conducting customer research in 2001 to better understand what factors C&I customers (including small, medium and large customers) consider before investing in energy efficiency, and the extent to which these serve as barriers to investing in energy efficiency and participating in the Programs.

Summary: Cost-Effectiveness Objective

Overall, 1999 programs were cost-effective according to the Department's approved methodology in 1999. As discussed, the Division anticipates that cost-effectiveness ratios will increase in the year 2000 and beyond, reflecting the Department's new cost-effectiveness guidelines.

Note: As of the writing of this report, the Department had not yet approved preliminary 1999 energy savings estimates filed by the Program Administrators. Final 1999 savings estimates were filed in the fall of 2000 for Department approval in 2001. Once approved, energy savings

[35] For example, the method for allocating administrative costs across programs changed for one Program Administrator, thus bringing down the benefit cost ratio for several of their C&I programs; in some cases, program participation may have decreased for a program (and thus savings), yet program costs did not; and in the case of one C&I program, the program ended in 1998 but costs were incurred in 1999 to perform an evaluation on the program.

data will be updated. Any substantial changes to the cost-effectiveness reported here will be presented in the Division's 2000 annual report.

4.2 Equitable Allocation of Funds Objective

Low Income Energy Efficiency Services
Nearly 18,000 low-income customers were served with $11 million in energy efficiency activities during 1999, resulting in estimated annual bill reductions of $47 per participating customer. Services provided included customer home energy audits, education about the customers' electric bills, replacement of high energy-use refrigerators, and installation of measures, such as compact fluorescent lighting. These programs also provided wall and ceiling insulation and programmable thermostats to electric space heat customers. All measures were provided at no cost to low-income customers. As directed by the Act, the electric ratepayer-funded low-income programs were delivered by the Weatherization Assistance Program and fuel assistance program network and were coordinated closely with the gas utility energy efficiency programs (through the Low-income Energy Affordability Network).

The Act directs the Division to ensure that Program activities are equitably allocated among customer sectors. Absent an explicit definition provided by the Act, the Division interprets "equitable allocation" to mean that the amount of funds collected from a specific customer sector should ideally be expended on that sector, but that circumstances may not always warrant such proportional allocation.[36] Further, judgement as to whether funds are equitably allocated is influenced by specific requirements set forth in the Act. The Legislature, acknowledging that low-income households are not likely to be served by the competitive energy market, directed funding levels for low-income programs to be no less than the greater of 0.25 mills per all kWh sold by electric distribution companies, or 20 percent of the total residential budget. Therefore, a minimum portion of collected funds is allocated to this customer sector, and if necessary, should be subsidized equitably by funds collected from Residential and C&I sectors.[37] The Division's analysis herein considers total funds available in 1999 for different customer sectors, and compares them to expenditures (plus year-end fund balances) for each sector.[38]

4.2.1 1999 Total Available Funds

The funds available in 1999 to support Program activities included 1998 carryover funds plus interest and 1999 ratepayer collections based on the mandated charge of 3.1 mills per kWh sales. Table 8 summarizes the funds available by customer sector. Total available funds in 1999 were $146.5 million ($10.1 million in 1998 carryover funds and $136.5 million in 1999 collections).

[36] A strictly proportional allocation could cause Program Administrators to forgo inequitable investment opportunities that significantly lower system costs, thus benefiting all customers, over alternative equitable investments. Furthermore, due to the vagaries of program implementation, exact allocations would be a goal that would be difficult to implement since many implementation activities are beyond the control of the Program Administrators (e.g., vendors become behind schedule, customers do not respond to marketing, etc.) Also, program plans are often altered significantly before they become actual program expenditures.
[37] As put forth in the Division's Energy Efficiency Oversight Guidelines supporting its regulation 225 CMR 11.0.
[38] Note that for the purposes of this report, the Division does not compare the equitable allocation below to a similar analysis provided in its 1998 annual report, due to a slightly different methodology used.

Table 8: 1999 Total Available Funds

Customer Sector	1998 Carryover millions $	1998 Carryover percent	1999 Collections millions $	1999 Collections percent	Total Available Funds millions $	Total Available Funds percent
Low-Income	0.3	3	8.5	6	8.7	6
Residential	7.1	71	37.2	27	44.3	30
C&I	2.7	27	90.8	67	93.5	64
Total	10.1	100	136.5	100	146.5	100

Source: Division of Energy Resources, 1999 Compilation of Program Statistics Reported by Program Administrators
Note: Percent totals may not add up due to rounding

Total 1999 collections represented roughly 3.5 percent of total distribution company electric revenues for the year.[39] The availability of funds for the C&I, Residential and Low-income sectors were 64, 30, and 6 percent, respectively.

4.2.2 1999 Expenditures and Year-End Fund Balance

Given Total Available Funds were $146.5 million in 1999, and Expenditures totaled $125 million, Table 9 shows a $21.6 million year-end fund balance that was carried forward to 2000. Note that expenditures reported include *all* 1999 energy efficiency expenditures, including administration, marketing, program implementation, program evaluation and performance incentives paid to the Program Administrators.[40]

[39] Note that this value is based on regulated distribution company total electricity revenues, and does not include generation revenues from competitive retail suppliers selling electricity in Massachusetts in 1999. If competitive supplier revenues were included, then energy efficiency fund collections would represent a smaller percentage of total electricity revenues from ratepayers.

[40] The 1999 expenditures of $125 million do not reflect $6.7 million representing amortized expenses for Boston Edison Company from the early 1990s. At that time, the Department of Telecommunications and Energy approved the amortization of energy efficiency program expenses in order to avoided increasing electricity rates for Boston Edison customers. As part of the 1998-2002 Energy Efficiency Plan settlement agreement reached between Boston Edison and the non-utility parties (Attorney General's Office, the Conservation Law Foundation, the Division of Energy Resources, the Northeast Energy Efficiency Council, and The Energy Consortium), it was agreed that Boston Edison would amortize $15.9 million of its unamortized costs in 1998, and the remainder ($6.7 million) in 1999. Note that these costs were not included in the cost-effectiveness analyses for 1998 or 1999 because they were included in such analyses in the years in which the costs were actually incurred and the energy efficiency measures were installed. As such, they are not reported herein in order to avoid confusion.

Table 9: 1999 Expenditures & Fund Balance

Customer Sector	1999 Expenditures millions $	1999 Expenditures percent	1999 Fund Balance millions $	1999 Fund Balance percent	Expenditures Plus Fund Balance millions $	Expenditures Plus Fund Balance percent
Low-Income	11.1	9	1.0	5	12.1	8
Residential	29.5	24	8.4	39	37.9	26
C&I	84.4	68	12.2	56	96.6	66
Total	125.0	100	21.6	100	146.6	100

Source: Division of Energy Resources, 1999 Compilation of Program Statistics Reported by Program Administratiors
Note: Percent totals may not add up due to rounding

The reasons for the year-end carryover were threefold. First, 1999 program budgets were based on the mandated mill rates and forecasted kWh sales. Actual sales were higher than forecasted sales, producing a surplus of funds. Second, a portion of 1999 funds was *committed* to energy efficiency projects but not yet expended as of year-end. Third, some programs were not fully implemented since their introduction in 1998. Therefore, unexpended funds plus interest were carried forward to 2000. The Division anticipates that the 1999 fund balance and year-end balances for 2000 and 2001 will be fully committed to specific energy efficiency projects by year-end 2002.

The largest portion of 1999 expenditures was spent on the C&I sector (68 percent), followed by the Residential and Low-income sectors at 24 and 9 percent, respectively. Year-end fund balances for 1999 was 21.6 million, over half of which was for the C&I sector, followed by the Residential and Low-income sectors.[41] The allocation of Total Expenditures Plus Fund Balance was 66 percent to the C&I sector, 26 percent to the Residential sector, and 8 percent to the Low-income sector. These are the values that the Division compares to the percentage breakout of Total Available Funds to analyze equitable allocation, as discussed below.

4.2.3 Equitable Allocation Analysis

In reporting on whether Total Available Funds were allocated equitably to the different customer sectors in 1999, the Division looked at both Expenditures as well as Expenditures Plus Fund Balance at year-end for each customer sector. The latter provides the more accurate representation of whether funds were allocated equitably relative to Total Available Funds. For example, while actual expenditures in 1999 may not have been equitably expended due to

[41] The 1999 year-end Fund Balances for each customer sector are based on the 3-year Energy Efficiency Plans filed by the Program Administrators for 2000-2002.

various reasons, equitability may have been preserved if an appropriate amount of funds at year end was carried forward to the following year's budget and used for the same customer sector.

Table 10 compares 1999 Total Available Funds to Expenditures Plus Fund Balance in dollar and percentage terms.

Table 10: Comparison of 1999 Total Available Funds to Expenditures Plus Fund Balance

Customer Sector	1999 Total Available Funds		1999 Expenditures + Fund Balance	
	million $	percent	million $	percent
Low-Income	8.7	6	12.1	8
Residential (non L/I)	44.3	30	37.9	26
C&I	93.5	64	96.6	66
Total	146.5	100	146.6	100

Source: Division of Energy Resources, 1999 Compilation of Program Statistics Reported by Program Administratiors
Note: Percent totals may not add up due to rounding

For the Low-income sector, a comparison of Total Available Funds in percentage terms (6 percent) versus Expenditures Plus Fund Balance (8 percent) suggests that a small portion of Low-income expenditures were subsidized. Similarly, for the C&I sector, Total Available Funds in percentage terms (64 percent) was lower than Expenditures Plus Fund Balance (66 percent), indicating that this sector was also subsidized. The Residential sector appears to have subsidized both other sectors, based on the fact that its Expenditures Plus Fund Balance (26 percent) were 4 percent less than Total Available Funds (30 percent).

While a certain level of subsidy towards the Low-income sector is appropriate given mandated funding levels for the Low-income sector, the fact that the C&I sector did not contribute to the Low-income sector at all, and further was subsidized by Residential sector, raises equity concerns.

Based on the Division's interpretation of equitable allocation, the Low-income subsidy of $3.4 million shown in Table 10 should have been allocated equitably between the Residential and C&I sectors. This would have preserved the equity provisions in the Division's Energy Efficiency Guidelines and maintained consistency with the Act. Had such equitable allocation occurred, the respective allocation of funds to the Residential and C&I sectors would have been 32 and 68 percent, respectively, as shown in Table 11. Instead, actual allocation of funds was 28 and 72 percent, respectively, a difference of 4 percent.

Table 11: Comparison of Equitable Versus Actual Allocation of 1999 Funds (Residential and C&I Sectors Only)

Customer Sector	Equitable Allocation of 1999 Funds millions $	percent	Actual Allocation of 1999 Funds millions $	percent
Residential	43.2	32	37.9	28
C&I	91.2	68	96.6	72
Total	134.4	100	134.5	100

Source: Division of Energy Resources, 1999 Compilation of Program Statistics Reported by Program Administratiors. Note: Percent totals may not add up due to rounding

Table 11 more clearly demonstrates that the Residential sector fully subsidized the funding shortfalls for both the Low-income sector ($3.4 million) and the C&I sector ($3.0 million). Equitable allocation would have required that the $3.4 million subsidy to the Low-income sector be proportionately allocated to the Residential and C&I sectors, at 32 and 68 percent, respectively. The Division intends to work with Program Administrators and key stakeholders to ensure that going forward, funds between these two sectors are more equitably allocated.

Summary: Equitable Allocation Objective

The Division concludes that 1999 energy efficiency funds were not significantly inequitably allocated across customer sectors. However, it observed that the C&I sector did not sufficiently contribute to supporting Low-income program funding, and was further subsidized by the Residential sector. The Division intends to work with Program Administrators and key stakeholders to adjust program budgets in the future to ensure equitability.

CHAPTER 5: BALANCING SHORT- AND LONG-RUN SAVINGS FOR CUSTOMERS

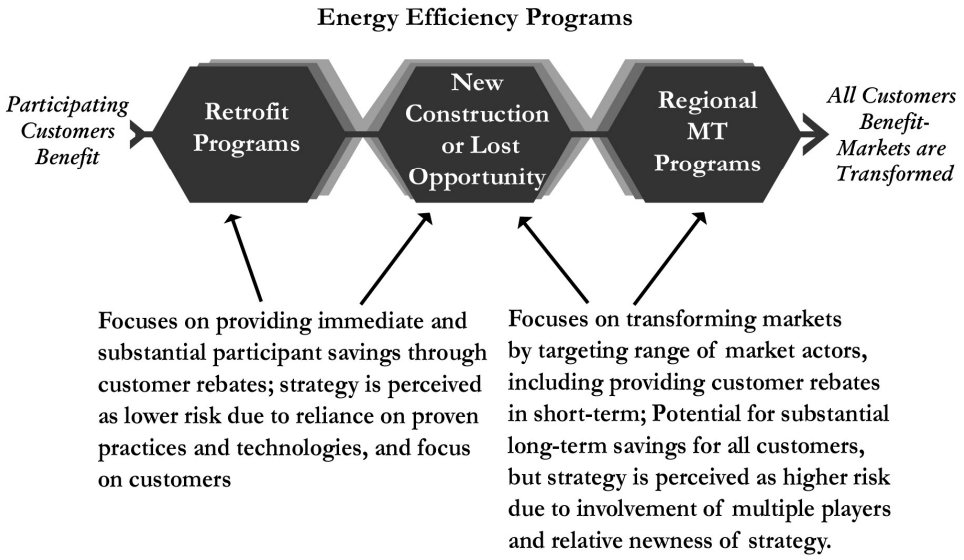
5.1 Background on Balancing Savings Objective

Ratepayer-funded energy efficiency programs are intended to serve two fundamental purposes: to provide immediate savings for *participating* customers, while also laying a broader foundation for future savings for *all* customers through the development of a competitive energy efficiency market. This latter objective requires that programs be deliberately designed to tackle the market barriers that stand in the way of the competitive market's offerings of energy efficiency products and services to all classes of customers. Appendix D describes a number of price-related and structural barriers, including incomplete information, poor access to both capital and high efficiency equipment, split incentives in third party situations such as lease, rental or other property management arrangements, and so forth.

Removing existing barriers to the use of energy efficient products and services helps to change – or transform – those markets so that they can support a more fully competitive market in the future. Thus, "market transformation" is not a label that uniquely identifies certain energy efficiency programs at the exclusion of others. Rather, market transformation *is an objective* that all energy efficiency programs have the potential to achieve, to at least some extent. Some programs are designed to accomplish specific changes in markets. Other programs may have effects on markets without necessarily targeting those effects as a program objective.

In this framework, market transformation may be thought of as a continuum along which energy efficiency program designs fall. The major types of energy efficiency programs offered in 1999 were Retrofit programs, New Construction (or Lost Opportunity) programs, and Regional Market Transformation programs (which are coordinated with other states in the region). These program strategies span across this market transformation continuum (Figure 4), and are discussed in turn below.

Figure 4: Market Transformation Continuum



5.2 Types of Energy Efficiency Programs

In 1999, the portfolio of energy efficiency programs did not change significantly from 1998. Program Administrators offered a range of programs targeted at residential, commercial and industrial customers. A more detailed description of programs, including how programs are designed to address specific barriers to investing in energy efficiency, is provided in Appendix K.

5.2.1 Retrofit Programs

In-Home Services Programs

A number of distribution companies offered in-home services in 1999. These programs provide comprehensive, whole-house retrofit services and education to residential customers with high levels of electricity consumption. Eligible customers receive an energy audit, education on energy savings opportunities, direct installation (free of charge) of low cost efficiency measures and 75% discounts on the installation of major (higher cost) conservation measures. For example, Roger Masson of Acushnet, MA, participated in Commonwealth Electric's Power Smart Residential High Use Program in 1999. The energy efficiency services installed in Mr. Masson's home included energy efficient lighting , air sealing, attic insulation, ventilation, and duct sealing measures. Mr. Masson contributed $447 toward the total cost of measures of $3,903. Annual savings from these measures were estimated to be 5,980 kWh, and lifetime savings of 119,675 kWh. These savings translate to approximately $718 in annual electricity cost reductions for Mr. Masson, or $13,000 over the life of the measures.

At one end of the market transformation spectrum are Retrofit programs (referred to as "In-home Services for the residential sector). These programs are designed primarily to provide immediate energy savings and cost reductions to participating customers beginning upon installation and continuing over the lifetime of the conservation measures in their home or facility. They target existing facilities or homes with functioning, but older, less efficient equipment, and offer rebates to encourage replacement of the outdated equipment with higher efficiency products. Rebates are designed to buy down the equipment cost to an acceptable payback period for the customer (usually less than five years). In 1999, as in 1998, retrofit programs served as a cornerstone of program offerings, accounting for the largest portion of energy efficiency expenditures.

Retrofit programs may also have effects on transforming markets, in the near- and long-term. By targeting particular technologies and practices, facility managers and trades people are introduced to new products. Theoretically, they become more willing to use the products elsewhere without

Transforming the T-8 Ballast Market

A good example of a retrofit program market impact in Massachusetts is the transformation of the electronic ballast market for certain C&I lighting markets (specifically for large C&I lighting markets) in the early 1990s. As a result of collective action by many electric utility retrofit programs, the manufacturing and distribution channels for electronic ballasts were improved to the point where this technology has become standard practice for certain C&I segments, and rebates are no longer needed for large C&I customers. Thus, ratepayer lighting retrofit programs not only delivered savings to participating customers, but they also transformed the market for the higher efficiency equipment, thereby making this technology widely available and affordable. Because of greater market barriers facing small and medium C&I customers, further assistance is needed through ratepayer funded energy efficiency programs to target the electronic ballast market.

ratepayer subsidies. Similarly, manufacturers are more willing to produce products for larger and more stable markets

Charlton Police Department Retrofit Project
In 1999, Charlton Police Department participated in Massachusetts Electric's Small C&I Program which installed energy efficient lighting fixtures that included T-8 lamps. The Small C&I Program provided the customer with $1,873 in incentives, which when coupled with the Police Department's contribution of $384, brought the total project cost to $2257. The estimated annual savings from this energy efficiency installation was approximately 20,751 kWh or $2,179 in electricity savings.

The risk of retrofit program strategies is low relative to other program strategies. Because these programs often focus on proven technologies and practices, they virtually guarantee savings to the customers. Retrofit programs also only involve a limited number of actors (usually only the vendor providing services to the customer), and thus are not dependent on successful interaction and coordination of several different market players.

5.2.3 New Construction (or Lost Opportunity) Programs

Large Industrial Customer Participates in Lost Opportunity Program
Nortel Networks of Chelmsford, Massachusetts is a manufacturer of unified network solutions. Nortel Networks has been an active participant in Massachusetts Electric's energy efficient new construction program, Design 2000 Plus. In 1999, Nortel elected to install high efficiency lighting systems and to convert an existing chiller plant to a comprehensive chiller system in several of their facilities. Nortel received incentives of $965,634 to help defray some of the cost for these improved system upgrades. The estimated annual electricity savings were 1,818,263 kWh, providing estimated cost savings of $145,461 to the customer in 1999, and substantially more over the life to the more efficient system.

The next largest portion of funding in 1999 was spent on New Construction (or Lost Opportunity) programs. These programs focus on encouraging investment in higher energy efficiency at the time of a naturally-occurring market event, such as construction of a new home or building, major expansion, renovation or remodeling, or replacement of failed equipment.[42] New Construction/Lost Opportunity programs are located roughly in the middle of the market transformation continuum shown in Figure 4. They are similar to Retrofit programs in that they use rebates to induce customers to install higher efficiency equipment than they would normally. This provides immediate and long-term savings to the participants. However, they also aim to transform markets by focusing on influencing key market players – including architects, designers, and builders – to upgrade standard building practice, building codes, and appliance standards. In fact, ratepayer-funded New Construction/Lost Opportunity programs have played a critical role in helping to upgrade state building codes and federal appliance standards. In order for Program Administrators to claim credit for these program energy savings, measures must *exceed* existing code and standards, thus driving the market towards higher efficiency codes and standards. Thus, as a result of these programs, all customers benefit over the long-term in addition to the savings realized by program participants.

[42] The use of the term "lost opportunity" refers to the opportunity to invest in energy efficiency that would otherwise be lost during a naturally-occurring market event, such as the new construction or major renovation of a building.

5.2.4 Regional Market Transformation Programs

At the other end of the market transformation continuum are programs that are primarily designed to change a technology or service market at the regional level (e.g., the Northeast),[43] so that it ultimately delivers energy efficiency products to *all* customers in the long-run, not just to those customers that participated in the programs. Regional Market Transformation programs in the Northeast are in most cases coordinated by the Northeast Energy Efficiency Partnership, and involve many other energy efficiency program administrators from neighboring and regional states, as well as coordination with other organizations and state or federal agencies (e.g., EPA's Energy Star Program). Like Retrofit and New Construction/Lost Opportunity programs, they often employ customer rebates for selected high efficient equipment to motivate customers to opt for higher efficiency equipment, and thus yield immediate savings to participating customers. However, the Regional Market Transformation programs primarily target the full range of market players – including manufacturers, retail suppliers, architects, engineers, builders, as well as consumers – in order to eliminate barriers across the entire spectrum of the market chain that impede the commercialization of high efficiency equipment.

Northeast Energy Star Residential Lighting Program

The Northeast ENERGY STAR Residential Lighting initiative, facilitated by the Northeast Energy Efficiency Partnership, is a partnership effort sponsored by utilities and state energy offices in New England and New York. Begun in 1997, the initiative is coordinated with the Consortium for Energy Efficiency and other national programs to build demand and increase the availability of high efficiency residential lighting products, as well as ENERGY STAR Lighting Fixtures. In 1999, initiative sponsors, including the Massachusetts Program Administrators, documented that customers purchased over 607,000 ENERGY STAR compact fluorescent bulbs (CFLs). Further evidence of progress towards transforming the residential lighting market is reflected by the growing number of manufacturers that offer qualified ENERGY STAR lighting products, the wider range of product availability in terms of size and light distribution, and the increasing number of retailers that participated in the Northeast ENERGY STAR initiative. In addition, prices for ENERGY STAR CFLs have declined considerably, from an average price of $17 five years ago, to under $10 per bulb today.

Regional Market Transformation programs rely on changing the behavior of many market actors, and are relatively new compared to the more traditional Retrofit and Lost Opportunity program strategies. Therefore, there is a higher perceived risk with Regional Market Transformation programs relative to Retrofit and Lost Opportunity programs. However, at the same time, these programs have the potential for greater substantial and sustainable long-run savings than for other programs. Their objective of changing markets over time leads to leveraging greater private investment in energy efficiency over the longer term. For example, Regional Market Transformation programs typically include training for trade allies. The trained trade allies become more knowledgeable and comfortable with the technical requirements of high efficiency equipment. They are thus more likely to recommend these products to all of their customers, and not just to program participants. Thus, the benefits of Regional Market Transformation programs accrue to a much wider range of customers, and not only program participants.

[43] The premise of these programs is that technology markets typically function at a regional or national level, and not a smaller levels (such as a state). Thus, in order to transform a particular technology market, this program strategy targets the various players in that technology market at the regional level.

C&I Regional Market Transformation Program Activities

The Program Administrators participated in various regional market transformation programs in 1999, with the objectives of performing preliminary research needed to characterize specific technology markets, develop market structure, standards, and educational materials, and in some cases to pilot- or move to full-scale program implementation. Program initiatives included the Northeast Premium Efficiency Motors Initiative, the Unitary HVAC Equipment Efficiency Program, Building Codes and Standards, C&I Lighting, and Compressed Air Systems. The Northeast Premium Efficiency Motors Initiative (now referred to as the "Motor Up Initiative") is facilitated by Northeast Energy Efficiency Partnerships, Inc., and is an example of a C&I regional market transformation program. This initiative aims to change the regional and national marketplace for general purpose 3-phase motors by increasing customer awareness, product availability and sales of qualifying premium efficient motors, thus reducing the incremental cost of premium efficient motors relative to standard motors. In 1999, regional sponsors contributed over $600,000 for marketing and educational purposes, as well as for motor rebates. Future plans for this program are to establish an ongoing mechanism for customers to readily distinguish premium motors in the market place (such as through ENERGY STAR labeling), and to expand the focus of the initiative to promote quality and efficiency in motor repair and motor system services.

5.2.5 Educational Programs

While all 1999 programs had an educational component to them, some programs focused exclusively on increasing customer awareness of energy efficiency. In 1999, educational programs focused primarily on the EnergySmart home auditing software (see textbox below). As valuable as the computer operated EnergySmart program is, it is only utilized by a computer equipped and literate subset of residential customers.

Home Energy Auditing Software

A key educational program offered in 1999 was the *EnergySmart* auditing software. Developed by Nexus Energy Software, Inc., the software allows residential customers to analyze energy use in their own homes. The analysis includes typical appliance energy use, energy savings opportunities, associated costs and benefits, and other information. *EnergySmart* is available in CD-ROM format or can be downloaded directly off of distribution companies' web sites. Some versions allow access to an "Account Link" feature through which residential customers can download their monthly electric energy consumption and cost information.

While the Division views this software as being a very useful tool to assist residential customers in learning about how they can make their homes more energy efficient, more focus should be placed on educational programs targeting a wider range of audiences. For example, a number of school educational (high school and trade school) programs offered in 1998 were discontinued in 1999. Given the importance of educating the public about energy efficiency, especially in light of increasing fuel prices and system reliability concerns, the Division plans to work with Program Administrators and key stakeholders to address this issue in the future.

Energy Conservation Services

In 1999, there were over 36,000 residential energy audits conducted through the Program Administrators' ECS program, focusing on providing customers with a computerized energy audit of their home based on specifications of the house (age, # of rooms/windows, etc). Recommendations were made about how the efficiency of the home could be improved based on the audit results. Participants were provided a certain level of free services, such as insulation of hot water heaters. In 1999 the Division worked with key stakeholder groups to develop draft regulations to convert the Energy Conservation Services Program to the Residential Conservation Services (RCS) Program, with the intention of redirecting the program towards achieving greater implementation as well as continuing its educational value.

Educational programs most appropriately fit on the far right of the market transformation continuum because they attempt to target all customers. However, in reality it is virtually impossible to measure their impact on transforming markets. This is one of the key challenges of educational programs – while they play a critical role in educating targeted audiences about energy efficiency, it is almost impossible to determine their cost-effectiveness (a criteria required by the Restructuring Act)

5.2.6 Other Programs

In 1999, a number of distribution companies offered load management programs, which primarily constitute the "Other" program category. These programs consisted mostly of C&I interruptible service programs, where large C&I customers were paid credits if they agreed to reduce their electricity load when called upon by their distribution company during capacity shortage or emergency situations. In 1999, participating C&I customers received $3.8 million in interruptible service credits, thus providing them immediate "savings." Because these programs also helped to maintain system reliability, they benefited all customers in 1999 as well, as discussed earlier in Chapter 3.1.

Table 12 summarizes the short- and long-term benefits of different program strategies funded by ratepayer energy efficiency funds.

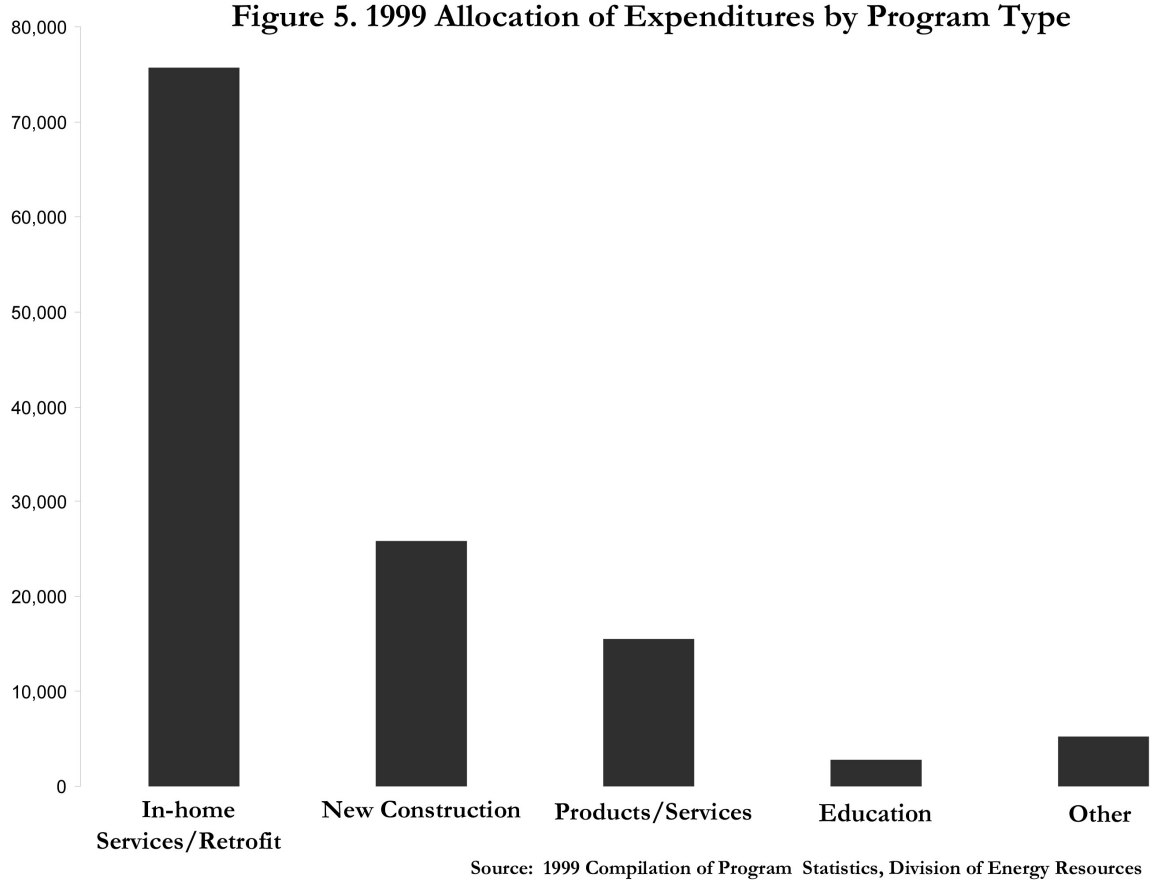
Table 12: Summary of Program Strategies

Program Type	Short-Term Energy Savings	Long-Term Energy Savings
Retrofit Programs (or In-home Services)	Substantial immediate energy savings and cost reductions to participating customers, primarily through the provision of rebates.	Programs have long-term saving impacts over the life of the installed conservation measures . However, savings beyond the life of the measures may not be achieved if markets have not been transformed.
New Construction (or Lost Opportunity) Programs	Substantial immediate energy savings and cost reductions to participating customers through the provision of rebates.	Programs have long-term saving impacts over the life of the installed conservation measures . Savings beyond the life of the measures may be achieved as a result of changing standard building practice and upgrading building codes or standards.
Products and Services	Some immediate savings for participating customers through rebates, but the savings ramp-down as the energy efficient product market begins to transform.	Potential for long-term savings is large if technology markets are successfully transformed, thus benefiting not just participating customers, but all customers.
Educational Programs	Focuses on increasing customer awareness about energy efficiency products, and helping customers understand how they can reduce their electricity bills. Difficult to quantify energy savings in short-run.	Focuses on increasing customer awareness about energy efficiency products, and helping customers understand how they can reduce their electricity bills. Difficult to quantify energy savings in the long run.
Other Programs (e.g., Load Management Programs)	Helps customer achieve immediate savings by shifting electricity use to less costly periods of the day, or paying credits to customers for disrupting service during capacity shortage and emergency periods.	Historically, load management programs have helped to reduce demand for electricity, and thus costs to all customers over time by prolonging the need to build new generation capacity.

5.3 1999 Program Expenditures and Savings by Program Type and Customer Sector

Figure 5 summarizes program spending by the types of programs discussed in the previous section.

Figure 5. 1999 Allocation of Expenditures by Program Type



Source: 1999 Compilation of Program Statistics, Division of Energy Resources

In 1999, a total of $125 million of ratepayer-funds was invested in Program activities. The majority of these investments were in Retrofit programs, representing 61 percent of all program expenditures, while New Construction/Lost Opportunity programs represented about 21 percent of total expenditures. Funding for Regional Market Transformation programs was 12 percent in 1999, while Educational and Other Program expenditures were 2 percent and 4 percent of total expenditures, respectively.[44]

[44] Compared to 1998, total expenditures in 1999 increased by over $25 million, the majority of which ($19 million) went towards Retrofit projects, followed by New Construction and Regional Market Transformation program activities ($4 and $5 million, respectively). These increases were offset by decreases in funding for Education and Other Program activities ($6 and $4 million, respectively).

Table 13 summarizes 1999 expenditures[45] and savings by program type and customer sector. Key highlights in this table include the following:

- Low-income program spending concentrated exclusively on In-home service projects, and represented 9 percent of total program spending in 1999. Associated lifetime energy savings from Low-income program activities represent 6 percent of total 1999 lifetime savings.
- The largest fraction of program spending for the Residential sector was targeted to Regional Market Transformation programs (11 percent), followed by In-home Services (7 percent). Lifetime energy savings to Residential customers are primarily attributable to these two types of programs, at 10 percent and 5 percent, respectively.
- Almost 68 percent of total 1999 energy efficiency expenditures were directed toward C&I programs, of which the majority funded retrofit projects, followed by New Construction/Lost Opportunity projects.
- The majority of lifetime energy savings from the 1999 programs, or 77 percent, are attributable to the C&I programs – more than half of which are due to the C&I Retrofit programs, followed by New Construction/Lost Opportunity projects.
- Regional market transformation program savings are understated for both the Residential and C&I sectors, since not all Program Administrators reflected the long-term savings impacts of these programs (i.e., market effects) in their reported savings.

[45] Expenditures reported in Table 12 include *all* 1999 energy efficiency expenditures, including administration, marketing, program implementation, program evaluation and performance incentives paid to the distribution companies.

Table 13: 1999 Expenditure and Savings by Program Type and Customer Sector

Customer Sector	Program Expenditures millions $	% of Total	Program Savings Annual (million kWh)	Lifetime	Lifetime % of Total
Low-Income					
In-home Services	11.1	9	15	211	6
Subtotal	11.1	9	15	211	6
Residential					
In-home Services	8.7	7	13	202	5
New Construction	3.7	3	3	37	1
Regional MT	13.3	11	36	388	10
Info & Education	2.8	2	2	18	0
Other	1.0	1	0	0	0
Subtotal	29.4	24	54	639	17
C&I					
Retrofit	55.9	45	141	1,993	52
New Construction	21.9	18	57	933	24
Regional MT	2.2	2	5	46	1
Info & Education	0	0	0	0	0
Other	4.4	4	0	0	0
Subtotal	84.4	68	203	2,984	78
Total	124.9	100	272	3,822	100

Source: Division of Energy Resources, 1999 Compilation of Program Statistics Reported by Program Administratiors
Note: Percent totals may not add up due to rounding

It is also useful to note in Table 13 that comparing program expenditures to program lifetime savings by customer sector (as percents of totals) shows that for the Low-income and Residential sectors, expenditures are greater than the associated lifetime savings. The opposite is the case for the C&I sector. This is an issue of program cost-effectiveness, which is discussed in Chapter 4.

Summary: Balanced Savings Objective

A balanced portfolio of programs should ensure immediate savings to participating customers, while also providing for the transformation of energy efficiency markets on a permanent basis. This essentially requires that programs, where possible, be designed to leverage non-ratepayer funded activities. The extent to which ratepayer funds are able to leverage private funds is an important indicator of success in transforming energy markets.

The portfolio of program strategies in 1999 did not change dramatically relative to 1998. For the Residential sectors, the most significant changes occurred with greater investments being made in Regional Market Transformation programs, and increased investments for Low-income customers, both of which the Division views as positive trends to helping effectively transform energy efficiency markets.

For the C&I sector, the majority of funds continued to focus on Retrofit programs, followed by New Construction/Lost Opportunity programs – all of which provided participating customers with substantial and important immediate savings. Although these program activities contributed

to long-term energy efficiency market change, the Division recommends that more emphasis be placed on evolving Retrofit and New Construction/Lost Opportunity programs so that they bring about permanent changes to energy efficiency markets, thus benefiting all C&I customers. Specifically, the Division recommends that they:

- Be designed to leverage private-sector activities more aggressively;
- Focus on trade ally education; and
- Be coordinated with Regional Market Transformation programs to the greatest extent possible so that energy efficient product markets can be transformed more effectively.

Further, as experience with Regional Market Transformation programs increasingly demonstrates quantifiable changes in market share for specific energy efficiency technologies, funding for these types of programs should be expanded. The Division views increased spending and savings in 1999 for these programs as a positive outcome for both the Residential and C&I sectors.

Finally, the Division recommends that, with increasing concerns about system reliability issues, Program Administrators should place greater emphasis on designing certain residential and C&I programs to specifically address the goal of reducing electric energy use during peak demand periods. This is especially critical during peak summer hours when electricity demand is typically at its highest, and the system can become seriously constrained. The Division plans to work with Program Administrators and key stakeholders to further explore this issue, including consideration of implementing aggressive and timely residential air conditioner programs, and C&I chiller, building operation and maintenance, and commissioning programs.

CHAPTER 6: DEVELOPMENT OF A COMPETITIVE ENERGY EFFICIENCY MARKET

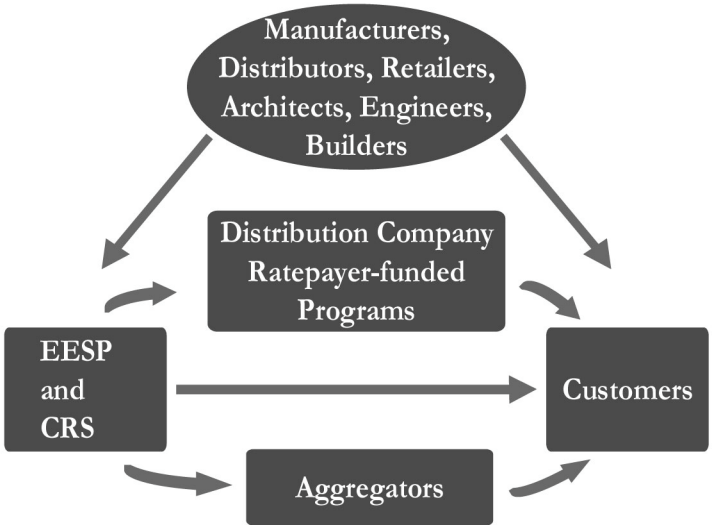
6.1 Key Players and Activities in the Energy Efficiency Market in 1999

The competitive energy efficiency market in Massachusetts includes a variety of market players, including:

- Energy efficiency service providers (EESP), including traditional energy service companies, that provide energy efficiency services to customers through private activities and/or through ratepayer-funded programs;
- Competitive retail suppliers (CRS) that bundle energy efficiency services with commodity and other services;
- Product manufacturers, distributors, dealers, and other retailers; and
- Design and construction professionals such as architects, engineers, lighting designers and builders.

All of these actors have played, and continue to play, critical roles in influencing the choice of energy equipment and/or in delivering energy efficiency products and services to customers, and reducing barriers to consumer energy efficiency investments. Figure 6 illustrates the interrelationships between these market players, and is followed by a discussion of 1999 activities.

Figure 6: The Flow of Products and Services in the Energy Efficiency Market



6.1.1 Energy Efficiency Service Providers and Competitive Retail Suppliers

Over the past decade or more, EESP have traditionally provided energy efficiency products and services to customers either directly or through ratepayer funded program activities. A new market player – competitive retail suppliers – began offering a range of energy services in 1998, including energy efficiency services, to customers as a bundled product with energy commodity sales and delivery. These services were provided either directly to customers or partnered through aggregators, and in some cases referred customers to participate in Program activities administrated by the distribution companies. However, in 1999, the Division observed that energy efficiency offerings from CRS declined. An overview of the types of energy efficiency services provided by EESP and CRS is provided below.

(a) EESP Active in Ratepayer-funded Energy Efficiency Programs

During 1999, the majority of all ratepayer-funded energy efficiency programs was delivered by EESP under contract to Massachusetts electricity distribution companies. EESP provided an array of energy efficiency services under these programs, including program design and implementation, marketing and evaluation. Competitive procurement of distribution company administered energy efficiency programs has been important to the growth and development of the Massachusetts energy services industry. In addition, ratepayer-funded programs have also allowed EESP to leverage efforts in existing markets and promote performance contracting[46] in new markets.

(b) EESP Offering Independent Efficiency Services

Many Massachusetts EESP provide services independent of either competitive retail suppliers or ratepayer-funded activities. The magnitude of this activity in 1999, however, is unknown. The Division will be researching the scope of this market in 2001 through surveys, focusing on the following categories of independent EESP:

- **Third-party financing[47] and performance contracting services –** typically referred to as "traditional energy service companies, or ESCOs", these companies provide services to large commercial and industrial customers primarily through performance contracting. The types of services include replacement of lighting systems, air compressors, chillers and boilers.

- **Municipal and state building efficiency services -** EESP provide energy conservation and efficiency improvement services to the Massachusetts Division of Capital Asset Management (DCAM), which manages the design and construction process for all state building projects (e.g., courthouses, correctional facilities, and state and community

[46] Performance contracting refers to contracts for energy efficiency services wherein payments to the ESCO are made on the basis of measured energy savings.

[47] Third-party financing is where a separate entity (a third party) provides a loan to a customer that wishes to invest in energy efficiency so that the customer can pay, in full, the vendor (ESCO) providing it services, and pay off the loan to the third-party over time.

college buildings). Energy efficiency services are provided either through performance contracting or bond-funded projects.

- **Load management services -** offered to large commercial and industrial customers. These services include measures or actions taken to alter the time pattern of energy use, such as shifting electricity use to hours or periods during the day when electricity is cheaper through the use of metering and control systems.

Energy Efficiency in State Buildings.
In 1999, the Massachusetts Division of Capital Asset Management (DCAM) managed a number of energy efficiency projects throughout the state. Three performance contracting projects were either initiated or ongoing during this time. These included: Mass College of Liberal Arts, Mass College of Liberal Arts' Skating Rink, and UMass Medical School. These three projects represented a total investment in energy efficiency equipment of $29,276,688, with guaranteed annual savings to the state of $3,843,281. In addition, there were ten performance contracting projects that have completed construction which are being monitored. These projects represent a total investment of $17,027,433, with total savings to date of $5,274,118. Finally, $1,003,384 was received from electric distribution companies as rebate incentives for the installation of energy efficient equipment at various facilities in the course of building construction and renovation projects.

(c) Competitive Retail Suppliers Bundling Energy Efficiency with Commodity

In the Division's 1998 Energy Efficiency Report to the Legislature, the Division reported several new energy efficiency offerings in the market in 1998. Competitive retail suppliers began to offer energy services, including energy efficiency, bundled together with electricity commodity. These services were offered primarily to medium and large C&I customers, although there was some activity in the residential market as well.

C&I Customer Offerings. In addition to electricity commodity services, competitive retail suppliers offered energy services in 1998 that focused heavily on load management (i.e., advising customers on how to shift their energy use to periods during the day when electricity is cheaper), and power quality services. These services included energy audits of customers' facilities, with recommendations for improvements in building and process efficiency. Audited customers could then choose to participate in ratepayer-funded programs for financing assistance, or could choose to receive services directly from an EESP vendor referred by the competitive retail supplier. In 1998, these new competitive retail suppliers included Exelon Energy Services, PG&E Energy Services, and Select Energy.[48]

The Division informally surveyed these three competitive retail suppliers during 2000 to determine whether and how their energy efficiency activities progressed in 1999. The Division found that in the case of Exelon Energy Services, which served as an aggregator to the

[48] These competitive retail suppliers also partnered with energy aggregators to provide bundled commodity/energy efficiency services to customers. These aggregators included the Massachusetts Health & Educational Facilities Authority, the Massachusetts High Technology Council, and National Energy Choice (for the Massachusetts Municipal Association). These aggregators administered the contracts (for commodity and energy efficiency services) between the competitive retail suppliers and customers, and in some cases provided financing options.

Massachusetts Health and Education Facilities Authority's (HEFA) *Power Options* program, no energy efficiency services were offered in 1999. While over 20 HEFA customers had signed up for energy audits in 1998 through combined energy efficiency/electricity commodity services, HEFA is not aware that any of the customers followed up on these audits. Similarly, PG&E Energy Services, which offered both electricity commodity and other energy services to the Massachusetts High Tech Council (MHTC), signed up a large percentage of its customers to participate in energy audits in 1998. However, in 1999, PG&E Energy Services (then New Energy) was sold to ENRON, and energy services focused on electricity commodity only. According to MHTC, greater emphasis is being placed on providing energy information (e.g., web based real-time price information) to customers, and there is little focus, if any, on energy efficiency services. Finally, in the case of Select Energy, which contracted with National Energy Choice and the Massachusetts Municipal Association to supply electricity and other energy services, 18 customers had energy audits performed on over 35 facilities during 1999. Of these audits, ten proposals were prepared and delivered to customers by Select Energy for their review and evaluation, but no customer acted on the proposed recommendations during 1999. The reasons for this were attributed to customers' decisions to either not pay for the cost of the audits or not make the recommended investments, as well as problems related to executing the energy efficiency contracts.

These examples clearly indicate that energy efficiency activities provided to medium and large C&I customers by competitive retail suppliers were minimal during 1999, and less active than in 1998. While this decline in activity may be partly due to the limited activity in the competitive electricity market in general, it also points to the fact that competitive retail suppliers are focusing on developing bundled packages that provide the greatest overall cost savings to customers, primarily through competitive commodity prices and energy information services (e.g., load management, real time pricing information). The provision of energy efficiency services does not appear to be a priority. It is important to note that in the informal surveys summarized above, it was not known to what extent the competitive retail suppliers referred their customers to ratepayer-funded programs. Further, the examples provided above only reflect activity between customers who contracted with competitive retail suppliers through an *aggregator*. The Division did not observe the extent to which energy efficiency services were provided to customers that *directly contracted* with competitive retail suppliers for bundled services.

Residential Customer Offerings. While a number of internet companies began offering electricity services to residential customers in Massachusetts in 1998 and 1999, such services focused on a range of energy commodities (electricity, natural gas, heating oil) bundled with other services such as telephone and internet access, but did not include energy efficiency services. These internet companies included www.servisense.com, www.esssential.com, and www.utility.com. The only internet source offering energy efficiency services was www.energyguide.com, an energy information center that provides residential customers and small businesses with information regarding energy provider options in their town/city, as well as extensive information about how to improve the efficiency of homes/buildings, information about energy efficiency products, and links to the customers' local distribution company for information about ratepayer-funded energy efficiency programs. While Energyguide.com is not a

competitive retail supplier itself, the company is an important information source and venue for residential customers and small businesses to explore energy efficiency opportunities and to purchase products.

The Division will continue monitoring changes in the competitive retail supplier market, primarily through a formal survey of retail competitive suppliers during 2001 which will assess: 1) in which states retail competitive suppliers are offering and providing energy efficiency services, 2) to which customer sectors (e.g., residential and small/medium/large C&I) are energy efficiency services being offered, and to what extent are the different sectors responding to such offerings, and 3) how retail competitive suppliers view opportunities for selling energy efficiency services in Massachusetts. The Division will report on the outcome of this survey as part of a 2001 report to the Legislature regarding the future of electric ratepayer-funded program activities in Massachusetts.

6.1.2 Product Suppliers and Design Services

Energy services companies represent only one segment of the energy efficiency market depicted in Figure 6. As illustrated, manufacturers who make high efficiency products, wholesalers and retailers who stock the products, and architects, engineers and builders who use the products are essential players as well.

- **Design, engineering and construction entities –** Architects, engineers, lighting designers, and a host of associated professions provide design specifications regarding energy efficiency for their customers' home or facility. Construction personnel may fulfill the specifications, and in many cases, provide their own recommendations.

- **Manufacturers** – Manufactures of energy efficiency equipment must invest in product research and development to provide energy efficiency improvements to the market.

- **Product distribution chain** – Wholesalers, distributors and retailers that carry and recommend energy efficiency products and services are a critical link between manufactures and consumers. They must be fully knowledgeable about, and comfortable with recommending high efficiency equipment to their customers.

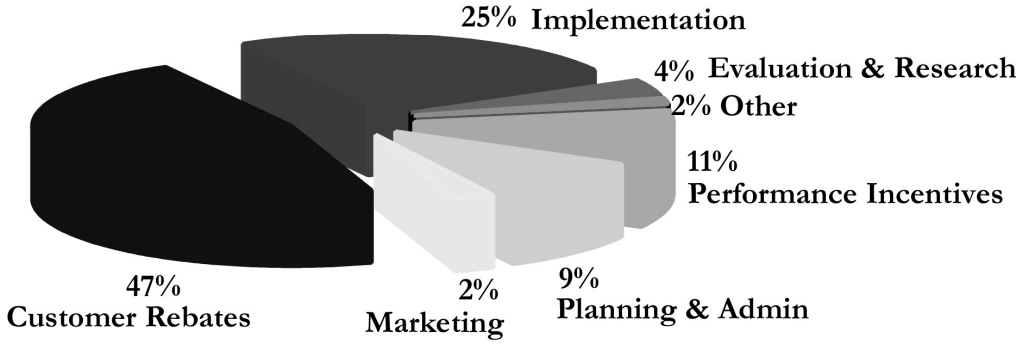
To expand the Massachusetts competitive energy efficiency market will require change among these market players in terms of how they manufacture products and provide design guidance and equipment specification. These actions are necessary to transform energy efficiency markets on a permanent basis. As mentioned above, the size and scope of product suppliers and design services market in Massachusetts is unknown at this time. The Division intends to study this market through survey research in 2001 in order assess the level of activity being provided by these businesses.

6.2 Competitive Procurement of Ratepayer-Funded Programs

At the end of 1999, the Division made several observations about indicators of progress toward increasing competition in the energy efficiency industry. While little or no progress was made in increasing competition for energy efficiency services through competitive retail suppliers, other EESP activities provide a measure of competitiveness. The Act requires that competitive procurement processes be used to the greatest extent practicable when delivering programs to Massachusetts' customers. These procurement processes benefit customers in two important ways. First, they result in lower, competitively set program costs. Second, they may also introduce innovative elements to program designs and/or implementation.

Competitive procurement processes are typically utilized by Program Administrators to obtain services in some aspects of program administration, marketing, implementation, customer rebates (i.e., the processing of the rebates), and program evaluation. In 1999, these cost categories represented 89 percent of total ratepayer-funded energy efficiency expenditures, as shown in Figure 7. Only the 11 percent of costs for performance incentives (those rewards earned by the distribution company for achieving specific program performance goals), and most internal administrative expenses are not subject to competitive procurement.

Figure 7: 1999 Electric Distribution Company Expenditures by Cost Category Total = $ 125.0 million



Source: 1999 Compilation of Program Statistics, Division of Energy Resources

Of the $125.0 million spent on Program activities in 1999, $95.8 million was spent on services contracted through energy efficiency service providers. Further, as shown in Table 14, almost all of these contracted services ($94.5 million) were secured through a competitive procurement. This amount represents 76 percent of total 1999 expenditures. The majority of these competitively procured services were related to customer rebate related expenditures, followed by program implementation, evaluation, and marketing. The remaining 24 percent of total expenditures that was not competitively procured was comprised mainly of program administrative costs and performance incentives. On balance, the provision of ratepayer-funded energy efficiency services in 1999 relied substantially on competitive procurement processes, and was relatively unchanged from 1998 performance.

Table 14: Procurement of Ratepayer-Funded Energy Efficiency Activities

Cost Category	Internally Expended Activities (percent)	Competitively Procured Activities (percent)	Total Expenditures (percent)
Rebates to Customers	0	47	47
Implementation	2	23	25
Performance Incentives	11	0	11
Administration	9	0	9
Evaluation	1	3	4
Marketing	0	2	2
Other	2	0	2
Total	24	76	9

Source: Division of Energy Resources, 1999 Compilation of Program Statistics Reported by Program Administratiors. Note: Percent totals may not add up due to rounding

Summary: Development of Competitive Market Objective

The Division observed a decline in energy efficiency services offered by competitive retail suppliers. While most suppliers offered energy efficiency related services in 1998, fewer did in 1999, a trend that may be due partly to the limited activity in the electricity market in general, but also due to certain barriers customers face (e.g., paying for up front costs of energy audits), and a greater emphasis being placed on other energy cost savings strategies, such as load management services. The Division will continue to follow these activities, as the electricity commodity market becomes more competitive over time, to assess the role that competitive retail suppliers play in providing energy efficiency services.

CHAPTER 7: CONCLUSIONS AND FUTURE OUTLOOK

The Division concludes that 1999 energy efficiency program activities continue to meet or make progress toward the statewide energy efficiency goals. Program activities provided direct benefits to participating customers as well as indirect benefits to the Commonwealth as a whole. In this report, the Division identified several areas that need further focus or attention, including:

- placing greater emphasis on developing end-use programs that can help increase system reliability by reducing demand during peak-use hours;
- determining the long-term impacts of program activities on reducing air emissions;
- ensuring that program funding is spent equitably across all customer sectors, given mandated Low-income funding requirements; and
- designing programs to leverage private-sector activities more aggressively.

The impact of 1999 program activities, as well as experience from other years, will serve as the basis for the Division's recommendation to the Legislature during 2001 concerning the future of electric ratepayer-funded energy efficiency activities beyond 2002. In addition, the Division is currently undertaking extensive research that will help inform its recommendation to the Legislature, including addressing the following key questions:

1) What energy efficiency opportunities remain in the State for different customer sectors?
2) How likely can the remaining opportunities be achieved during the five-year period 2003-2007, with and without ratepayer-funded support?
3) What barriers do customers face to investing in energy efficiency?
4) To what extent are competitive markets for energy efficiency products and services developing, particularly in regard to the provision of such services by competitive retail suppliers?

These questions will be addressed based on the following research activities:

- Compiling and analyzing existing data by end-use (e.g., specific technologies) for the residential sector and various C&I sectors to estimate remaining cost-effective energy efficiency opportunities in the state, including the remaining energy savings that could potentially be captured with and without ratepayer-funded energy efficiency programs.
- Conducting surveys and/or focus groups of residential and C&I customers to identify (a) whether/why these customers have or have not participated in ratepayer funded programs, (b) to better identify barriers these customers face to investing in energy efficiency, and (c) to determine the extent they have been offered or provided energy efficiency services by competitive retail suppliers.
- Surveying energy efficiency service providers and competitive retail suppliers in Massachusetts, as well as other deregulated states, to determine the extent that energy efficiency services are being offered or provided to customers.

The answers to these questions will enable the Division to assess whether and to what degree energy efficiency programs should continue to be funded by mandated ratepayer contributions.

APPENDICES

A: Glossary of Terms
B: The Division's Oversight of Energy Efficiency Activities
C: Energy Efficiency Working Group Stakeholder List
D: Common Barriers to Investing in Energy Efficiency
E: 1999 Electricity Bill Impact Analysis Methodology
F: Wholesale Energy Clearing Price Impact Analysis
G. Job Impact Analysis - REMI Model Overview and Assumptions
H. Air Quality Effects of Electricity Generation
I: Air Emission Reduction Analysis - Energy 2020 Model Overview and Assumptions
J: Program Savings Review and Approval Process
K: Overview of 1999 Programs by Customer Sector

Appendix A: Glossary of Terms

Administrator - See "Program Administrator."

Annual Savings – Energy (kWh) and/or capacity (kW) savings from energy efficiency programs that accrue to customers in a single year. Typically, when evaluating programs, Program Administrators report annualized savings, which reflect savings from the installation of energy conservation measures assuming the measures were all installed at the *beginning* of the year, as opposed to the middle or end of the year. While this may overstate annual savings in the first year, the savings average out over the lifetime of the energy conservation measures.

Coordinated Programs - These are programs that are implemented by multiple administrators in a consistent manner, but are not jointly implemented.

Demand Savings – Represent the impact that energy efficiency programs have on reducing demand (in the form of kilowatts or kW) on the electricity system during very high or "peak" periods, when the cost of electricity is more expensive.

Demand-Side Management (DSM) - Refers to energy efficiency or load management programs funded by electric ratepayers that can be implemented to increase the efficiency of energy use by end users or alter energy consumption usage patterns.

The Department - Massachusetts Department of Telecommunications and Energy.

The Division - Massachusetts Division of Energy Resources.

Distribution Company – Refers to electric distribution company or Program Administrator

Energy Efficiency Program - Energy efficiency products, features, and services designed to reduce the amount of electricity used to serve energy end-uses (such as lighting, heating, and cooling) among residential, commercial and industrial customers. A combination of these activities bundled into a program with a single budget is evaluated for cost effectiveness.

Energy Savings - Represent the electricity savings available immediately to customers in the form of bills lowered because fewer kilowatt-hours (kWh) were used.

Energy Service Company (ESCO) – Refers to companies that provide performance contracting energy efficiency services to large commercial and industrial customers.

Energy Efficiency Service Provider (EESP) - Generally applies to companies that provide any type of energy efficiency service or product.

Jointly Implemented Program - An energy efficiency program implemented by several administrators jointly. Examples include programs implemented by Northeast Energy Efficiency Partnerships (NEEP) programs and the Joint Management Committee (JMC).

Lifetime Energy Savings - Refers to the cumulative electricity savings resulting from the installation of an energy conservation measure, such as a compact fluorescent, over the life of the measure. The "life" of an energy conservation measure begins when the measure is installed, and can last as long as 20 years.

Lost Opportunity Program – A type of program that captures energy efficiency opportunities at the time of a naturally occurring market event, such as new construction, expansion, renovation, and replacement of failed or retired equipment.

Market Barrier - Customer barriers to investing in energy efficiency products and services as a result of: initial high transaction costs for energy efficient equipment, performance uncertainties, lack of product availability, lack of information about energy efficiency products and services, lack of access to financing, and misplaced or split incentives. An example of split incentives arises in rental property where the landlord has no incentive to install energy saving measures in the building because he/she does not pay the electricity bill, and the tenant has no financial interest in doing so because he/she is not in a position to authorize the installation of such measures, such as installing energy efficient appliances, heating systems, lighting etc.

Market Transformation - Generally refers to the process by which collective actions, policies, and programs affect a positive, lasting change in the market for energy-efficient technologies and services. It is one of the goals of many energy efficiency programs, especially some of the regional initiatives.

Mill - A mill is one-tenth of a cent or one-thousandth of a dollar.

Municipal Aggregator - Any municipality or group of municipalities exercising the powers or authorities granted by G.L. 164, §134.

Municipal Energy Plan - A plan developed by a municipality (or group of municipalities) pursuant to G.L. c. 164, §134(b) that defines the manner in which the municipality proposes to implement demand side management and renewable energy programs.

Outsourced Activities - Energy efficiency activities delivered or services provided by entities other than the Program Administrator or its affiliate.

Payback Period – The amount of time it takes to recover the higher cost of energy efficiency equipment. The payback period varies depending on what technologies and/or applications are being considered.

Performance Contracting - Performance contracting refers to contracts for energy efficiency services wherein payments to the ESCO are made on the basis of measured energy savings.

Program Administrator – Any electric utility distribution company or municipal aggregator authorized by the Department to utilize ratepayer funding to implement an energy efficiency program.

Retrofit Program – A type of program that seeks to exchange functioning equipment with higher efficiency equipment, or to induce efficiency where it is not present.

Appendix B: The Division's Oversight of Energy Efficiency Activities

Relevant Sections of the Restructuring Act of 1997

Below are sections of the 1997 Restructuring Act relevant to the Division's role regarding energy efficiency activities. Language specific to the Division's responsibilities are highlighted.

Chapter 164 of the Acts of 1997

An Act Relative To Restructuring The Electric Utility Industry In The Commonwealth, Regulating The Provision Of Electricity And Other Services, And Promoting Enhanced Consumer Protections Therein.

SECTION 37.

Section 19. Beginning on March 1, 1998, and for a period of five years thereafter, the department is authorized and directed to require a mandatory charge per kilowatt-hour for all consumers of the commonwealth, except those served by a municipal lighting plant, to fund energy efficiency activities, including, but not limited to, demand-side management programs. Said charge shall be the following amounts: 3.3 mills ($0.0033) per kilowatt-hour for calendar year 1998; 3.1 mills ($0.0031) per kilowatt-hour for calendar year 1999; 2.85 mills ($0.00285) per kilowatt-hour for calendar year 2000; 2.7 mills ($0.0027) per kilowatt-hour for calendar year 2001; and 2.5 mills ($0.0025) per kilowatt-hour for calendar year 2002; provided, however, that in authorizing such programs the department shall ensure that they are delivered in a cost-effective manner utilizing competitive procurement processes to the fullest extent practicable. At least 20 per cent of the amount expended for residential demand-side management programs by each distribution company in any year, and in no event less than the amount funded by a charge of 0.25 mills per kilowatt-hour, which charge shall also be continued in the years subsequent to 2002, shall be spent on comprehensive low-income residential demand-side management and education programs. A distribution company shall not be allowed to assess any other charge relative to energy efficiency programs that would exceed the levels permitted herein. The low-income residential demand-side management and education programs shall be implemented through the low-income weatherization and fuel assistance program network and shall be coordinated with all gas and distribution companies in the commonwealth with the objective of standardizing implementation. On March 1, 2001, the division of energy resources shall, in order to determine if energy investments shall continue beyond that time, review then-current market barriers, experience with competitive markets, and related environmental and economic goals. If said division determines that the continued operation of the programs delivers cost-effective, energy efficiency services, said division shall file, with the clerk of the house of representatives of the general court, legislation to extend for a time certain the authorization contained herein for such a charge to fund energy efficiency activities.

SECTION 50.

Section 11E. The division of energy resources is hereby authorized and directed to monitor any independent systems operator or power exchanges organized pursuant to the provisions of chapter 164. The division shall determine the extent to which said operators and exchanges serve the needs of retail customers and contribute to the achievement of energy efficiency and fuel diversity goals as said goals are identified by the division and the department of telecommunications and energy.

The analysis and publication of all data and information collected by the division, shall be conducted to inform consumers, energy suppliers, the department of telecommunications and energy, and the general

court about the operation of retail markets and any deficiencies in the operation of those markets, and to recommend improvements to such. Said data and information shall be used by the division for the publication of periodic projections of the supply, demand, and price of energy on statewide and regional basis.

The division shall annually issue a report containing information on all issues of electricity system reliability, including, but not limited to, generation and transmission data detailing load and capacity, for the prior calendar year and forecasting potential future capacity excesses or deficits for the next five calendar years. The division shall utilize any and all information available to forecast potential capacity excesses or deficits, including, but not limited to, analyses by the independent system operator and other such data collected by the division pursuant to section 7. Said report shall contain (i) electricity spot price information for the previous calendar year, including, but not limited to, the average regional monthly spot price; (ii) a determination of the extent to which the energy markets are maintaining necessary levels of reliability; (iii) a determination of whether or not all customer classes are being adequately served by competitive energy markets; (iv) a determination of the competitiveness of energy markets; including a determination whether or not the electric industry is providing consumers with the lowest prices possible within a restructured, competitive retail marketplace; and (v) a determination of the extent to which the energy markets are achieving the energy efficiency and fuel diversity goals of the commonwealth. Said report may be undertaken in combination with the report required pursuant to section 7, at the discretion of the commissioner. Said report shall identify any substantial fluctuation or pricing differences in the cost of electricity available to consumers, especially with respect to geographic regions and low and moderate income consumers. Said reports shall make recommendations for improving any deficiencies so identified in electricity energy markets, including non-competitive pricing situations, which are within the authority of the general court, the department of telecommunications and energy, the federal energy regulatory commission, or any other governmental body with jurisdiction over the deficiency so identified. The division shall submit such report to the joint committees on government regulations and energy, respectively, and the house and senate committees on ways and means no later than April thirtieth of each year, including drafts of legislation to implement recommendations within such report.

Section 11G. The division of energy resources shall have the authority to oversee and coordinate ratepayer-funded energy efficiency programs. The division shall seek to achieve goals including, but not limited to, the following: (i) ensure that energy efficiency funds are allocated equitably among customer classes; (ii) ensure that there will be adequate support for "lost opportunity" efficiency programs in areas such as new construction, remodeling, and replacement of worn-out equipment; (iii) give due emphasis to statewide market transformation programs in order to systematically eliminate market barriers to energy efficiency goods and services; and (iv) provide weatherization and efficiency services to low-income customers. The division of energy resources shall annually file a report with the department of telecommunications and energy on the proposed funding levels for energy efficiency programs. The department shall review and approve energy efficiency expenditures after determining that implementation of such programs was cost-effective. Within one year of enactment of this legislation, the division shall conduct a public hearing process to investigate the role of the division in the oversight and statewide coordination of energy efficiency programs. Not later than March 1, 1999, the division shall promulgate rules and regulations necessary to implement the findings of this section.

Appendix C: Energy Efficiency Working Group Stakeholder List

	Company/Agency	Contact Name
1	Division of Energy Resources	Bruce Ledgerwood, Julie Michals
2	Department of Telecommunications and Energy	Barry Perlmutter, Gene Fry
3	Attorney General's Office	Ted Bohlen
4	Northeast Energy Efficiency Council/ Peregrine Energy Group	John Manning Paul Gromer
5	Conservation Services Group	Steve Cowell
6	Conservation Law Foundation	Richard Kennelly
7	Northeast Energy Efficiency Partnerships	Sue Coakley
8	The Energy Consortium	Roger Borghesani
9	Associated Industries of MA	Robert Ruddock
10	Low-income (WAP) Network	Elliott Jacobson Jerrold Oppenheim
11	Cape Light Compact	Maggie Downey, Tim Woolf
12	Bay State Consulting	John Shortsleeve
13	MASSPirg	Rob Sargent
14	National Grid (Massachusetts Electric Company)	Tim Stout, Carol White
15	NSTAR	Lisa Carloni, Tina Torres
16	Western Massachusetts Electric Company	Steve Waite
17	Fitchburg Gas and Electric Company	Deborah Jarvis
18	New Energy Ventures	Barbara Kates-Garnick
19	ENRON	Frank Rishe
20	MA Division of Capital Asset Mgmt.	Hope Davis
21	Dept. of Environmental Protection	Nancy Seidman
22	IRATE	Curt Collyer
23	Union of Concerned Scientists	Michelle Robinson
24	Clean Water Action	Cindy Luppi
25	Honeywell DMC	Anne Gross
26	MacGregor Energy Consultancy	Theo MacGregor
27	Berkshire/Fall River Gas	Emmett Lyne
28	Senator Steven Panagiotakos	D.J. Corcoran
29	Senator Michael Morrisey	Sandy Callahan
30	Representative John Binienda	Lisa (Yarid) Marsh
31	Representative Daniel E. Bosley	Kevin Grant

Appendix D: Common Barriers to Investing in Energy Efficiency

Historically, much of the rationale for public intervention in energy efficiency markets has been based on the fact that there is a large, well-documented gap between the level of investment in energy efficiency that appears to be cost-effective and the level actually found in the market. Advocates of intervention generally argue that this gap is caused by problems in the structure and functioning of markets for energy efficiency, and that these problems can and should be addressed through public means. Opponents of intervention tend to argue either that the efficiency gap does not represent a major source of economic inefficiency, or that whatever economic inefficiency exists cannot easily be addressed through public intervention.

In understanding this debate, it is helpful to draw a distinction between *market barriers* and *market failures.* A market barrier can be defined as any factor which helps to account for the discrepancy between the level of investment in cost-effective energy efficiency and the level actually found in the market. A market failure occurs when one or more market barriers results in an inefficient allocation of resources. Most of the debate about the appropriateness of public intervention in energy efficiency markets has hinged not on whether there are market barriers preventing individuals and businesses from installing cost-effective energy efficiency measures, but on whether or not these barriers constitute market failure and who should be responsible for addressing them.

I. Types of Market Barriers

Broadly, it is possible to distinguish between three classes of market barriers to energy efficiency: 1) barriers involving the price of energy and of energy efficiency measures; 2) barriers involving market structure; and 3) barriers involving limitations to the economic rationality of consumer behavior. Each of these classes is discussed in turn.

A. Price-Related Market Barriers

Price-related barriers to the adoption of energy efficiency measures include externalities, distortions in the price of energy, liquidity constraints, and high transaction costs.

A.1 Externalities. Perhaps the factor that is most widely accepted as a market barrier impeding the adoption of energy efficiency measures is the presence of significant external costs associated with the production and transmission of electricity (e.g., air pollution). Because these externalities are generally not reflected in the rates paid by electric utility customers, from a societal perspective they tend to result in an under-investment in energy efficiency.

A.2 Price Distortions. It is also generally accepted among energy economists that the existing structure of prices for electricity can incorporate significant distortions, which have the potential to skew investment in both supply- and demand-side resources. For example, depending on the specific time and region, marginal electricity rates in the U.S. have often been either well below or well above the marginal costs of production. From a societal perspective, the former scenario has the potential to lead to under investment in energy efficiency, while the later has the potential to lead to over investment. Further, electric rates often do not reflect the cost differentials associated with time-of-use, the geographic location of the customer being served, or the costs of either new or added load.

A.3 Liquidity Constraints and High First Costs. There are plenty of energy efficiency measures available in the marketplace that will pay back their incremental costs compared to standard measures

within a period of a few years or less. However, surveys of utility customers in all sectors consistently reveal that many feel they cannot afford to meet the up-front "first-costs" of such measures, regardless of how good an investment they may represent.

A.4 High Transaction Costs. Even if consumers can afford the first costs of energy efficiency measures, locating efficient equipment or services can often present substantial transaction costs. An example of such costs is the time required to go to multiple retailers to find one that stocks the equipment with the desired efficiency level, as well as desired secondary features. Another example is the cost of collecting detailed information on the performance of high-efficiency technologies, to determine whether their marginal cost over standard technologies is justified.

B. Structural Market Barriers

For the purposes of this discussion, the term "structural market barriers" includes all those market barriers to energy efficiency hinging on the role of individual market participants or on the patterns of stable relationships among participants. The following are examples of structural market barriers: third-party purchases; barriers to market entry; lack of market availability; infrastructure limitations; inseparability of product features; and imperfections in capital markets.

B.1 Third-Party Purchases. In many cases, the person or organization making decisions about the purchase of energy-consuming equipment is not the same person in the organization responsible for paying the bill to operate this equipment. The equipment purchaser thus has little, if any, motive to pay the incremental cost of energy efficiency. The most common example of this situation is when the owner of a residential rental property buys the appliances for it, while the tenants pay the utility bill. However, third-party purchases can also present a market barrier in the context of firms and other formal organizations, where the employee with responsibility for equipment purchasing may have little incentive to fully consider energy efficiency in making his or her decisions.

B.2 Barriers to Market Entry. One key requirement for the efficient operation of a market is that the barriers to entry for individuals or firms wishing to compete in the market are not insurmountable. Unfortunately, such barriers to entry are not at all unusual in energy efficiency markets. For example, the appliance industry is highly competitive with relatively stable (as opposed to growing) demand. High R&D costs are generally associated with the development of new energy efficient products. These high R&D costs represent barriers to entering the energy efficient appliance market. Similarly, some observers have argued that energy services companies (ESCOs) currently face prohibitive barriers to market entry due to dominance of the energy efficiency market by utilities.

B.3 Lack of Market Availability. Sometimes, energy efficiency measures cannot be found in a local market at *any* cost. An example from recent years is high-efficiency motors, which until recently were often not routinely stocked by distributors. Buyers with burnt-out motors would thus be forced either to buy a standard-efficiency unit on the spot, or wait for several days or weeks until a high-efficiency motor could be obtained

B.4 Infrastructure Limitations. Just as energy efficiency measures may be hard to find at a regional level, qualified firms and individuals to sell or service these products may be lacking as well. For example, market research studies have often found the diffusion of new energy efficient residential appliances to be hampered by the lack of repair workers experienced in servicing them.

B.5 Inseparability of Product Features. In the case of residential appliances, there is a documented tendency for energy efficiency features to be packaged along with luxury features (for example, through-the-door ice in a refrigerator). Its net effect is to lead to underinvestment in energy efficiency on the part of those consumers who cannot afford luxury features.

B.6 Imperfections in Capital Markets. Whatever the specific reasons, it has been well-documented that consumers purchasing energy-using equipment often employ discount rates many times higher than those used by utilities in making plant investment decisions. This can lead to substantial over-investment in electric generation resources, and under-investment in energy efficiency. In essence, those with the most incentive to pursue demand-side measures have prohibitively high discount rates.

C. Economic Rationality of Energy Consumers

Finally, regardless of whether the structure of energy efficiency markets and of the prices of energy and energy-consuming equipment are conducive to energy efficiency, there may still be barriers to the adoption of energy efficiency measures if consumers do not have perfect knowledge and full rationality. Two such barriers are discussed below: imperfect information and bounded rationality.

C.1 Imperfect Information. Economic theory holds that, for markets to allocate resources with perfect efficiency, there must be complete and identical information on the part of both buyers and sellers. However, energy efficiency markets depart from this ideal in a number of important ways. First, most utility customers receive bills which do not provide them with detailed end-use information on energy, making it difficult to assess the cost-effectiveness of individual energy efficiency measures. Second, information on the specific performance characteristics of standard and efficient measures not widely available. Third, and perhaps most important, there are often asymmetries between the level of information held by various market participants -- a condition known to have important implications for economic efficiency. Two common examples are the level of knowledge shown by building owners and tenants, and the level of expertise of appliance purchasers and appliance dealers.

C.2 Bounded Rationality. There is a growing body of behavioral research suggesting that, even when they have reasonably complete information, energy consumers do not consistently act to maximize the return on their investment in energy-using equipment. Instead, they tend to display what economists have come to call bounded rationality: behavior that shows some tendency to maximize utility, but deviates from the ideal of perfect rationality in the use of simplified information sets, heuristic rules for action, and the search for merely satisfactory rather than ideal outcomes. Bounded rationality has most often been cited in the context of individual consumers.

Appendix E: 1999 Electricity Bill Impact Analysis Methodology

The Division's 1999 energy efficiency bill impact analysis consisted of two parts. First, the Division analyzed the bill impact of energy efficiency program energy (kWh) savings for participating customers by key customer segments. This involved estimating the average annual energy charges that participants avoided as a result of energy savings due to energy efficiency equipment installations in 1999. These estimated avoided charges were based on the *variable* portion of the tariff for each rate class for each electric distribution company.

Second, the Division performed a bill impact analysis of the total avoided annual demand (KW) charges due to energy efficiency programs for those participants with such a component on their electricity bill. The calculation of avoided annual demand charges was based upon a weighted state average demand charge for demand savings over the year.

1. Energy Savings Bill Impact Analysis

Calculation of Avoidable Energy Charges. Avoidable energy charges (i.e. charges based on kWh consumption) over the period of 1999 were estimated for each distribution company by adding up all variable charges (i.e., not including fixed charges such as the customer charge) for each rate class, and then weighting the avoidable charges by the number of months they applied during the year. (This weighting was necessary because all distribution companies had at least one rate change during the year and some companies had two.) The resulting rate was thus a weighted average of the avoidable energy charges by rate class for each distribution company.

Estimate Average and Total Annual Bill Savings. Using energy efficiency program energy savings data for each rate class (provided by the distribution companies), the Division estimated average annual bill savings by multiplying the savings for each rate class by the avoidable energy charge for that rate class. The total of these bill savings was estimated to be $20 million, as follows:

Total Annual Bill Savings = Σ (S*AEC), where:

S = kWh savings from programs by rate class for each distribution company
AEC = Weighted avoidable energy charge by rate class for each distribution company

The Division aggregated the results for the rate classes for each distribution company into the following customer segments:

1) Low-income
2) Residential
3) Small C&I - rate classes with average monthly use of less than or equal to 3,000 kWh/month.
4) Medium C&I - Medium C&I includes rate classes with average monthly use greater than 3,000 kWh/month, but less than or equal to 120,000 kWh/month
5) Large C&I - rate classes with average monthly use greater than 120,000 kWh/month.

Total bill savings for each rate class were also divided by the number of participants reported by each distribution company to determine the average bill savings per participant.

Average Bill Reductions as a Percent of Total Average Annual Bills. The Division compared the average annual bill reductions by rate class to the average annual bill per participant (by rate class) to determine the percent reduction on an average annual bill, as follows:

Average Annual Bill per Participant =

(Average annual energy usage per participant * Total Weighted Tariff for Rate Class)

Similar to the process for estimating the average and total annual bill savings, the Division aggregated the results of its analysis into the customer segments described above.

2. Demand Charge Bill Impact Analysis

The Division's analysis of the demand charge bill impact for participating customers involved the following steps:

- Estimating a weighted average demand charge for *each* distribution company. This required multiplying the total demand charge (i.e., charge per kW peak in a billing cycle) per rate class by the number of participants in that rate class, adding across all rate classes for each distribution company, and dividing by the total number of participants for each company.
- The *total company* weighted average demand charge was then aggregated by adding the company weighted averages together and dividing by the total number of participants for all companies. The total weighted average demand charge was estimated to be $9.34 per KW.
- The total weighted average demand charge was multiplied by demand (KW) savings that accrued to C&I participants that were on a tariff with a demand charge. These demand savings of 46,000 (not including interruptible credit program savings) were based on summer/winter peak savings for all hours as reported by Program Administrators, and weighted over summer savings (5), and winter months (7). The Division's analysis assumed that individual customer peaks were coincident with system peak.
- The 46,000 in KW savings resulted in roughly $5 million in annual bill savings to participating customers, as shown in the table below.

	Total C&I KW Savings	Less Interrupt Credit Program KW Savings	KW Savings Weighted Over Summer/Winter
Summer Peak Savings	98,055	56,273	23,447
Winter Peak Savings	67,286	38,449	22,429
Avg. KW savings			45,876
Avg. $/KW monthly rate			9.34
Monthly Savings			$428,479
Annual Savings			**$5,141,754**

Appendix F: Wholesale Energy Clearing Price Impact Analysis

To illustrate the phenomenon of how ratepayer-funded energy efficiency programs can reduce wholesale energy market clearing prices, the Division looked at a 13-hour peak usage period (10am to 10pm) on June 7, 1999. The table below shows the ISO bidding data used by the Division to support its analysis. The analysis required comparing the day-ahead bid stack for selling electricity in the wholesale market with and without the impact of the 115 MW of demand savings resulting from the energy efficiency programs. Comparing column D to column E in each of the 13 hours shows how the prices differ due to the margin of 115 MW. The Division calculates that the reduction in demand of 115 MW may have avoided roughly $6.7 million in *additional* costs to the system (i.e., to all customers) over the 13-hr period analyzed. This was calculated by multiplying, in each of the 13 hours, the spot load (column E) times the difference in energy clearing price (ECP) with and without the 115 MW of demand savings resulting from the 1999 energy efficiency programs (columns D minus B).

ISO-NE Actual Energy Clearing Prices on June 7, 1999 Compared to Potential Energy Clearing Prices Without MA Energy Efficiency Program Impacts

	With EE		Without EE				Savings to
Hour	Total Load	ECP	Total Load	ECP	Spot Load		Spot Load
	A	B	C	D	E		F
10	18,343	$69.42	18,458	$71.00	2,498		$3,946.21
11	19,316	$109.08	19,431	$119.00	2,470		$24,500.04
12	19,834	$191.10	19,949	$280.00	2,544		$226,200.99
13	20,300	$476.15	20,415	$500.00	2,799		$66,757.74
14	20,531	$679.25	20,646	$999.00	2,819		$901,402.15
15	20,623	$615.74	20,738	$999.00	2,860		$1,095,968.59
16	20,826	$430.81	20,941	$475.00	3,092		$136,637.15
17	20,922	$401.40	21,037	$470.00	3,452		$236,806.64
18	20,635	$531.79	20,750	$999.00	3,509		$1,639,483.18
19	20,227	$519.55	20,342	$999.00	3,450		$1,653,893.76
20	19,886	$386.59	20,001	$465.00	3,231		$253,342.49
21	20,088	$218.75	20,203	$300.00	3,075		$249,851.92
22	19,462	$412.35	19,577	$470.00	3,039		$175,217.81
Avg.	**20,076**	**$387.84**	**20,191**	**$549.69**	**2,988**	**Total**	**$6,664,009**

Appendix G: Job Impact Analysis – REMI Model Overview and Assumptions

The Division used the REMI Economic and Demographic Forecasting and Simulation Model (REMI-EDFS) to determine the economic impacts of ratepayer-funded energy efficiency programs over time in the state of Massachusetts. The REMI-EDFS model, calibrated for the state of Massachusetts, is used in this study to represent the economic impacts over time, resulting from 1999 spending on energy efficiency programs.

The model integrates the key aspects of three economic modeling tools: (1) Input-Output (I-O) models; (2) Computer General Equilibrium (CGE) models; and (3) Econometric models. In general, it is able to forecast over 2000 output variables for the years 1999 to 2035 using a historical database that spans the years 1969 to 1998. However, in this study, the Division examined only three of these outputs over the forecast horizon through the year 2010: employment, as measured by number of employee-years; gross regional product (GRP), which provides an overall measure of economic production in the Commonwealth; and disposable income, which is the income (after taxes) to the population that results from this increased economic activity.

1. Overall Methodology. The REMI model first calculates a baseline forecast for the state of Massachusetts using historical data and the most likely scenario for future economic conditions. The analysis then incorporates any changes related to the energy-efficiency programs to the model – via policy variables – in order produce an alternative forecast (or simulation). This part of the analysis relied on Bill of Goods (BOG) data. The BOG data were developed by the Goodman Group, Ltd., and disaggregates energy efficiency expenditures to industry-specific expenditures.[49] The simulation results are then subtracted from the baseline forecast in order to produce the net impact of policy changes.

2. Steps. The REMI model analysis involved the following steps:

a. The Division ran a control forecast and examined the results for the outputs of interest.
b. Based upon 1999 energy efficiency expenditure data (including investments using ratepayer funds and participant costs), the Division established the amount by which each policy variable should be changed. This involved use of the BOG data to allocate energy efficiency expenditures to the relevant industries of the Massachusetts economy. As described below, changes in these industries' demands were input as policy variables to REMI.
c. The Division reran the model. A complete alternative forecast was created based on the policy variable changes.

[49] For efficiency technologies, BOG data were principally derived from Massachusetts utility accounting records, which incorporated all aspects of costs (program administration, overhead, labor, and consulting services, as well as materials and equipment).

d. The Division interpreted the impact of policy change by analyzing the differences between the alternative and the control forecast.

3. Policy Variables. The following policy variables were used to model expenditures on energy-efficiency products and services:

a. Increased demand for mining industry products/services. This variable includes spending on windows, insulation, solar water heating, lamps, lighting fixtures, HVAC controls, heating & cooling equipment, refrigeration, and motors.
b. Increased demand for rubber industry products/services. This variable includes spending on plastic products.
c. Increased demand for stone, clay, & glass products/services. This variable includes spending on mineral products.
d. Increased demand for machinery and computer equipment products/services. This variable includes spending on metal working, special industry, and general industry products.
e. Increased demand for railroad, trucking, air transportation, public utilities transportation, and other transportation industry services.
f. Increased demand for wholesale trade services.
g. Increased demand for professional and business services.

4. Results. The table below shows the results of the Division's REMI simulation. The employment impact is further broken down by industry detail.

Key Results	**1999**
GRP (million of 1999$)	72
Disposable Income (million of 1999$)	40
Total Employment (employees)	1,060
Employment By Sector (employees)	
Agriculture	4
Mining	9
Construction	94
Durable Goods	161
Non-durable goods	14
Transportation	30
Finance, Insurance, and Real Estate	38
Wholesale	84
Retail	119
Services	491
State & Local Government	15

5. Interpretation of Results. 1999 energy efficiency program activities generated an estimated 1,060 net new jobs in Massachusetts in 1999, contributing $72 million to the gross regional product (GRP). In addition, $40 million in disposable personal income was gained from these jobs, concentrating in the services, retail trade and manufacturing sectors. The impacts of 1999

ratepayer-funded energy efficiency activities on the Massachusetts economy occur over time. As expected the greatest impact is in the first year. Subsequent impacts (e.g., over a ten to fifteen year period) are lower as the increased demand from energy efficiency products is met. It is important to note that employment figures represent employee-years. Thus, future job impacts due to 1999 expenditures are not additional, "permanent" jobs created, but are jobs that remain in future years that were originally created in 1999. The largest employment sector is services and durable goods, followed by retail and construction – a result due to the nature of the energy efficiency products and the local economy. The $72 million in GRP provides an overall measure of economic production in the Commonwealth due to 1999 energy efficiency expenditures. Finally, as a result of 1999 activities, the Division estimates that $40 million in disposable income was created, which is the income (after taxes) to the population that results from this increased economic activity. As with employment, the GRP and disposal income figures decline over time.

Appendix H: Air Quality Effects of Electricity Generation

A description of and air quality effects of key pollutants emitted by electricity generation are summarized below:

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO). Nitrogen oxides (NOx), the term used to describe the sum of NO, NO_2 and other oxides of nitrogen, play a major role in the formation of ozone. The major sources of man-made NOx emissions are high-temperature combustion processes, such as those occurring in power plants and automobiles. Home heaters and gas stoves also produce substantial amounts of NO2 in indoor settings.

Health and Environmental Effects: Short-term exposures (e.g., less than 3 hours) to current nitrogen dioxide (NO_2) concentrations may lead to changes in airway responsiveness and lung function in individuals with pre-existing respiratory illnesses and increases in respiratory illnesses in children (5-12 years old). Long-term exposures to NO_2 may lead to increased susceptibility to respiratory infection and may cause alterations in the lung. Atmospheric transformation of NOx can lead to the formation of ozone and nitrogen-bearing particles (most notably in some western urban areas) which are both associated with adverse health effects.

Nitrogen oxides also contribute to the formation of acid rain. Nitrogen oxides contribute to a wide range of environmental effects, including potential changes in the composition and competition of some species of vegetation in wetland and terrestrial systems, visibility impairment, acidification of freshwater bodies, eutrophication (i.e., explosive algae growth leading to a depletion of oxygen in the water) of estuarine and coastal waters (e.g., Chesapeake Bay), and increases in levels of toxins harmful to fish and other aquatic life.

Sulfur Dioxide

Sulfur dioxide belongs to the family of sulfur oxide gases. These gases are formed when fuel containing sulfur (mainly, coal and oil) is burned and during metal smelting and other industrial processes. Most SO2 monitoring stations are located in urban areas. The highest monitored concentrations of SO2 are recorded in the vicinity of large industrial facilities.

Health and Environmental Effects: High concentrations of SO_2 can result in temporary breathing impairment for asthmatic children and adults who are active outdoors. Short-term exposures of asthmatic individuals to elevated SO_2 levels while at moderate exertion may result in reduced lung function that may be accompanied by such symptoms as wheezing, chest tightness, or shortness of breath. Other effects that have been associated with longer-term exposures to high concentrations of SO_2, in conjunction with high levels of PM, include respiratory illness, alterations in the lungs' defenses, and aggravation of existing cardiovascular disease. The subgroups of the population that may be affected under these conditions include individuals with cardiovascular disease or chronic lung disease, as well as children and the elderly.

Together, SO_2 and NOx are the major precursors to acidic deposition (acid rain), which is associated with the acidification of soils, lakes, and streams, accelerated corrosion of buildings and monuments, and

reduced visibility. Sulfur dioxide also is a major precursor to PM-2.5, which is a significant health concern as well as a main pollutant that impairs visibility.

Carbon Dioxide

The earth's climate is predicted to change because human activities are altering the chemical composition of the atmosphere through the buildup of greenhouse gases—primarily carbon dioxide, methane, and nitrous oxide. The heat-trapping property of these gases is undisputed. Although uncertainty exists about exactly how earth's climate responds to these gases, global temperatures are rising. Scientists generally believe that the combustion of fossil fuels and other human activities are the primary reason for the increased concentration of carbon dioxide. Plant respiration and the decomposition of organic matter release more than 10 times the CO_2 released by human activities; but these releases have always been in balance with the carbon dioxide absorbed by plant photosynthesis. Energy burned to run cars and trucks, heat homes and businesses, and power factories is responsible for about 80% of society's carbon dioxide emissions, about 25% of U.S. methane emissions, and about 20% of global nitrous oxide emissions. Increased agriculture, deforestation, landfills, industrial production, and mining also contribute a significant share of emissions.

Health and Environmental Effects: Rising global temperatures are expected to raise sea level, and change precipitation and other local climate conditions. Changing regional climate could alter forests, crop yields, and water supplies. It could also threaten human health, and harm birds, fish, and many types of ecosystems. Deserts may expand into existing rangelands, and the character of some of the U.S. National Parks may be permanently altered.

Source: U.S. Environmental Protection Agency, Office of Air and Radiation, 1999 www.epa.gov/oar

Appendix I: Air Emission Reduction Analysis – Energy 2020 Model Overview and Assumptions

The Energy 2020 model is an integrated energy model that contains detailed demand and supply sector simulations, including macroeconomic interactions as supplied by the REMI model (see Appendix G). The model is maintained by Systematic Solutions, Inc., and has been used extensively by over 50 utilities and states/provinces in both deregulated and transitioning environments. More recently, Energy 2020 has been used to examine the regional impacts of proposed Kyoto initiatives at the 50 state-level.

The Division's 1999 analysis of emission reductions used the Energy 2020 model to examine the impacts of energy efficiency programs on the price to generate electricity, which in turn impacts the decisions about the dispatch, building of capacity, and exports and imports of electricity to other regions. Thus, the model focuses on how energy efficiency programs reduce electricity demand, which in turn leads to a reduction in the overall price for electricity. This reduction in price can be quite dramatic when energy efficiency programs reduce peak demands. A reduction in price, while positive, can also produce disincentives for more expensive (and cleaner) plants, such as new combined cycle gas plants in a high-gas environment, to be dispatched or built. This occurs because reductions in price lead to reductions in revenues (current and anticipated), which results in reduced investment and dispatch in more expensive technologies.

The results of the model showed that a displacement of plants (according to fuel type) occurred in the following fashion due to the 1999 energy efficiency program related energy savings of 272 million kWh: 48% gas/oil steam, 24% coal steam, 20% gas/oil combined cycle, and 8% gas/oil turbines. The associated emission reductions in 1999 were 453 tons of nitrogen oxides (NO_X), 770 tons of sulfur dioxides (SO_2), and 145,000 tons of carbon dioxide (CO_2).[50]

1. Key Model Characteristics/Assumptions

The major assumption underlying the Energy 2020 model work is to use historical data (up to 1998) for model calibration. This is important given the recent dramatic changes in the energy environment since then, such as the higher oil and gas prices. This database essentially describes the "assumptions" underlying the model. However, the model's results are not completely traceable to these assumptions given the complexity of the internal system interactions.

In order to somewhat simulate recent changes (and include an important assumption that has major impacts on results), the Division ran the model in a higher-gas environment than was previously expected using the existing historic data. Additional corrections, such as knowledge of particular generation expansions not forecasted in the model are also possible and will be included in future analyses.

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[50] The primary difference between the 1999 emission reduction values and the 1998 values reported in the Division's 1998 Annual Energy Efficiency Report to the Legislature, is due to different modeling techniques used for each report. For the 1998 report, the Division used a static model with no deregulated dispatch routines, where a certain dispatch was assumed with concomitant emissions factors, and certain levels of emissions resulted. For the 1999 analysis, the Division used the Energy 2020 dynamic model described herein.

The third major assumption is the use of deregulated decision-making in terms of dispatch and capacity addition. Dispatch and generation decisions are made using the following technologies: oil/gas combustion turbine, oil/gas combined cycle, oil/gas steam turbine, coal steam turbine, advanced coal, nuclear, baseload hydro, peaking hydro, renewables, baseload purchase power contracts, baseload spot market, intermediate purchase power contracts, intermediate spot market, peaking purchase power contracts, peaking spot market, and emergency purchases. As seen by this list, both technologies and contract purchases can be made to service load requirements.

In sum, the Division's plans to conduct a more comprehensive environmental and price impact evaluation of energy efficiency programs next year, incorporating a range of factors into its model to simulate the long term impacts of the programs, including (a) the uncertainty about long-term fuel prices, (b) the implementation of potential stricter state and federal pollution standards on electricity generation plants, (c) changes in the portfolio of power plants in New England, and (d) the impact of energy efficiency on energy demand and the dispatch of power plants.

Appendix J: Program Savings Review and Approval Process

1. Overview of Process

The process for developing, reviewing and approving electric ratepayer-funded energy efficiency program savings is comprised of the following key steps:

a) Third-party entities are hired, often through competitive procurement processes, by Program Administrators to develop impact and process evaluations. These impact studies include estimates of annual energy and demand savings attributable to specific programs, and are developed using methodologies approved by the Department of Telecommunications and Energy (the Department).
b) During the time that evaluation studies are being planned and conducted, the Non-Utility Parties (NUPs) involved in the Collaboratives[51], with support from technical consultants, often review the process of arriving at the estimated savings, and provide important input about how to arrive at reliable savings estimates.
c) Program Administrators formally file: a) annual energy efficiency reports, and b) performance measurement reports (including impact and process evaluations) with the Department, at which time the Department opens a proceeding for interested party review and comment.
d) Interested parties occasionally contest savings estimates submitted by the Program Administrators in proceedings before the Department.
e) The Department reviews the savings estimates in detail, and frequently requires that they be revised.

The process for developing, reviewing and approving estimated savings from ratepayer-funded energy efficiency programs is extensive and rigorous, both in terms of the volume of information filed with the Department, and the extent to which revisions are required of the original savings estimates. For example, in a typical year, filings of savings estimates from all Program Administrators are backed by up to 40 volumes of studies covering over 20 programs, and comprising as much as 5,000 pages that analyze savings primarily by type of technology. The volumes are each authored by one to four third-party entities, representing 10-15 independent consulting companies. The Department formally examines these studies in 3 to 4 dockets, in which the Program Administrators respond to over a hundred data requests, including requests for re-analysis of savings under various assumptions. The data requests concentrate on areas where 90 to 98% of the claimed savings lie. The studies and data responses lead to 3-4 Department orders comprising 20-250 pages.

[51] There are currently three Demand-side Management (DSM) Collaboratives in the state (Massachusetts Electric Company, NSTAR, and Western Massachusetts Electric Company). Each collaborative is represented by a group of non-utility parties (with the assistance of technical consultants) and the Program Administrators. The non-utility parties include (not necessarily in each collaborative): the Attorney General's Office, the Conservation Law Foundation, the Division of Energy Resources, ENRON, IRATE, the Low-income Energy Affordability Network, the Northeast Energy Efficiency Council, and The Energy Consortium. These collaboratives develop and implement energy efficiency plans according to guidelines developed by the Division and the Department, and review program performance on an on-going basis.

In the past, the role of the NUPs in reviewing estimated savings has in some cases led the Department to require that Program Administrators use methodological guidelines set forth by the NUPs. In addition, the Department has also directed Program Administrators to re-estimate savings based on methodological flaws identified by intervenors in the relevant Department proceeding.

2. Development of Savings Estimates

Program Administrators begin by developing "tracking" estimates of savings, which are based on previous year savings. These tracking estimates are then evaluated by consultants as part of impact evaluation studies, and are typically revised (usually downward). In earlier program years (late 1980s and early 1990s), the evaluated savings were 30 to 130% of tracking savings estimates. Where consultants did facility-by-facility review (typically in large C&I programs), they would re-examine engineering assumptions and data, then measure loads, hours of use, and other pertinent factors, sometimes re-calibrating models, and revise estimates on a facility-specific basis, summing the information to obtain a program total savings estimate. For other types of programs, consultants have relied more heavily on the statistics of billing analysis, usually with carefully matched comparison groups, but have also used end-use metering. In early program years, the Department ordered substantial downward changes in evaluated savings submitted by Program Administrators in response to a variety of problems, sometimes by up to 40% for a program or 15% for a whole set of programs. Typical problems included unrepresentative samples, failure to account properly for non-program influences on energy use, inaccurate or unsubstantiated estimates of hours of operation, doubtful assumptions about persistence of savings, failure to account for improper installation and maintenance of equipment, and poor choice among equally valid estimates of program savings.

In recent years, evaluated savings have usually been 70-120% of tracking savings estimates. The Department has found fewer problems with evaluated savings as the quality of the savings evaluations has improved.[52] In general, samples are representative and well-stratified where appropriate, measurements are carefully taken, confounding factors are systematically accounted for, and proper statistical techniques are used. In addition, some Program Administrators have been able to file fewer evaluations, every second year (or less frequently for some pieces of some programs) instead of every year, using the results of past evaluations to a greater degree. With several recent evaluations, the Department has issued letter orders approving savings estimates as filed or as revised by the affected company during discovery to correct a few minor errors.

[52] Several persistent studies have also been performed, concluding that the indicated lifetimes for installed equipment have been consistent with the initial lifetimes assumed a decade ago, based on manufacturer specifications and other factors. Generally, equipment has not been in place long enough to give a good picture over the full expected life of the equipment, but observed failure rates during up to half the assumed equipment life are consistent with the assumed life for all the types of equipment reviewed. To date, fears that equipment lives are substantially shortened by changes in facility use and occupancy have not been substantiated.

Appendix K: Overview of 1999 Programs By Customer Sector

Below is an overview of 1999 energy efficiency programs, including highlights of program activities and accomplishments. The overview also addresses how programs are designed specifically to address barriers that customers face to investing in energy efficiency. For more detailed information on specific programs offered in electric distribution company service territories, please contact the relevant local distribution company.

1. Low-Income Programs

In 1999, nearly 18,000 low-income customers were served by $11 million in energy efficiency activities. The In-home Services program provides services to single family homes, multifamily buildings and new constructions projects that shelter low-income households in the Commonwealth. These services included customer home energy audits, an explanation of customers' electric bills, replacement of high-use refrigerators, and installation of energy conservation measures, such as lighting. All measures are provided at no cost to the low-income customers. Low-income programs also provided wall and ceiling insulation and programmable thermostats to electric space heat customers.

As directed by the Act, the low-income programs were largely administered and delivered by the low-income Weatherization Assistance Program (WAP) and fuel assistance program network ('the Network'), and coordinated closely with gas utilities through the Low-income Energy Affordability Network (LEAN). The majority of Low-income program activities was directed to services provided through the Low-income network, as required by the Act.

The Division estimates that roughly 27 percent of Low-income households (i.e., residential discount rate eligible households as defined by 175% of the federal poverty line) received a discounted electricity rate in 1999. This low enrollment level suggests that more needs to be done to enroll eligible customers onto the discount rate, which serves as a critical venue for enrolling customers in the energy efficiency programs provided through the Low-income network. The Division will be working with the Low-income Energy Affordability Network (LEAN) and the Department to develop guidelines on how to address this challenge.

2. Residential (Non L/I) Programs

2.1 In-home Services

The major barriers to reaching residential high use customers include:

- Split incentives between tenants and landlords;
- Lack of awareness of both the nature of efficiency opportunities and their benefits;
- High first cost of energy efficiency measures; and
- Lack of technology and infrastructure availability.

Residential in-home service programs are designed to overcome these barriers by increasing marketing efforts to raise awareness, and by installing energy efficiency measures at low (75 percent discount) or no cost to the customers. These programs provide comprehensive, whole-house retrofit services and education to single family and multi-family residential customers with historically high levels of electricity consumption. Eligible customers receive an energy audit, education on energy savings opportunities, direct installation (free of charge) of low cost efficiency measures and discounts on the

installation of major (higher cost) measures. The types of rebates offered on measures can include installation of lighting, air sealing to reduce drafts, and insulation. The eligibility criteria for participating in In-home Service programs has changed recently due to increased saturation of this market. Historically, customers with electricity consumption of at least 12,000 kWh per year were eligible to participate in In-home Service programs, but this threshold usage level is declining as some Program Administrators succeed in penetrating the high use market in their service territory. Thus, In-home Service programs are in some cases increasingly targeting customers with annual usage levels below 12,000 kWh per year.

2.2 Residential New Construction

To effectively incorporate energy efficient building methods and products into the residential new construction market, a number of barriers must be overcome. The major barriers can be summarized as follows:

- Higher first cost of energy efficient measures;
- Builders may be unwilling to adopt newer building technologies;
- Lack of a competitive market for companies that provide Home Energy Ratings;
- Lack of knowledge by consumers, builders, appraisers, lenders, and other key actors,
- of the full range of benefits of building energy efficient homes;
- Split incentives (landlord/tenant, builder/owner);
- Consumers' inability to differentiate between high efficiency and standard efficiency
- In the market; and
- Lack of consideration of the value of efficiency in financing.

In 1999, all distribution companies participated in the ENERGY STAR™ Homes Program, a national energy efficiency campaign sponsored by the Environmental Protection Agency (EPA) and the Department of Energy (DOE). This regional initiative was created to help home builders and buyers design and construct single-family and multi-family homes that use at least 15% less energy than homes built to Model Energy Code (MEC) standards. The program is co-sponsored by all Massachusetts investor-owned distribution companies, and Boston Gas Company.

The ENERGY STAR™ Homes Program includes elements designed to overcome many of the barriers to building energy efficient homes, including:

- Rebates on the purchase of energy efficient lighting and appliances, and possibly additional incentives to reduce "first cost" and split incentive barriers (e.g., provision of energy efficiency mortgages and reduction of certification fees);
- Home Energy Rating System (HERS) certification to all consumers, builders and other actors to identify efficient "quality" homes;
- Training and informational outreach to builders, architects, retailers and customers, to address "adoption" and "knowledge" barriers; and
- Working with financing entities to develop reduced interest rate mortgage products for HERS-certified homes, to overcome "financing" barriers.

As of December 1999, about 6% of the new homes in the state achieved ENERGY STAR standards, and the program is striving to reach 30% of the market by end of 2002.

Massachusetts Residential Building Code. During 1999, Program Administrators continued to support the implementation of the residential building code which took effect in March 1998, and initially involved intense outreach and training effort. The training continued into 1999 with sessions reaching approximately 1,565 builders, architects, students, and building officials at venues including: building material supplier "showcases" (contractor appreciation events), building official association meetings, and college classes. The topics covered various combinations of: 1) a complete introduction to the building code; 2) demonstrating compliance software; 3) window requirements; and 4) requirements for remodelers.

2.3 Residential Regional Market Transformation Programs

A number of residential Regional Market Transformation (MT) programs were offered in 1999, including the ENERGY STAR® Lighting Program (*StarLights)* and the ENERGY STAR™ Appliance program, which included the statewide clothes washer program (*TumbleWash*). Their overall goal is to transform the product market to one that sustains availability of and demand for quality, energy efficient lighting and appliance products.

ENERGY STAR® Lighting Program. The major barriers to developing a competitive market for higher efficiency lighting for residential homes include:

- Lack of consumer awareness of residential energy efficient lighting options (especially fixtures);
- Lack of consumer acceptance of high-efficiency lighting products;
- Lack of retailer/supplier interest in and support for energy efficient lighting products;
- Lack of builder/contractor interest in and support for energy efficient lighting products (primarily fixtures);
- Higher first cost;
- Limited product selection and availability; and
- Uneven product quality.

In collaboration with the Northeast Energy Efficiency Partnership (NEEP) and other electric utilities in the Northeast region, Massachusetts Program Administrators offer a common residential lighting program to their customers through the ENERGY STAR Lighting Program . This program has two components: a point-of-purchase retail lighting component, and a mail-order catalog. The ENERGY STAR Lighting Program intervention strategies have elements designed to overcome many of the barriers identified above, including:

- Marketing and consumer education campaigns;
- Point-of-sale displays and materials;
- Product specifications and compliance testing;
- Fostering new product development;
- Promotion and demonstration of product quality and benefits;
- Product and sales training;
- Product rebates and incentives;
- Leveraging of utility investment to secure matching rebates and other considerations;
- "Special Product" procurement and promotion; and
- Catalog sales for emerging products.

Over the past two years, significant progress has been made as joint utility programs have lowered marketing costs and increased manufacturer and retailer participation in the ENERGY STAR Lighting Program. In 1999, the StarLights program offered in Massachusetts provided over 300,000 and 130,000 rebates for bulbs and fixtures, respectively, totaling $5.3 million in rebates to residential customers. The Program Administrators estimate that of the 3.9 million households in the electric utility service territories combined, about 20.5% have received free bulbs and fixtures from ratepayer-funded programs since 1991. This indicates that while significant progress has been made to market higher efficient lighting to residential customers, further energy saving opportunities for lighting remain in this sector.

TumbleWash/ENERGY STAR™ Appliances Program. The Program Administrators and numerous other electric and gas utilities located in the Northeast have worked successfully with the Northeast Energy Efficiency Partnership (NEEP), with facilitation by the Consortium for Energy Efficiency (CEE), to establish a regional program (TumbleWash) that supports awareness and promotion of high-efficiency clothes washers. To date there are sixteen gas and electric utilities throughout Massachusetts, Connecticut, and Vermont involved in this effort, and a high visibility television advertising campaign has been launched. In 1998, Program Administrators joined a broad regional effort to offer a common residential ENERGY STAR™ Appliance program, into which the clothes washer program has been incorporated. The expanded program seeks to raise customer awareness of the importance and benefits of purchasing energy efficient appliances. The Program Administrators will also be working with CEE to encourage higher energy efficiency standards for qualifying ENERGY STAR-labeled appliances.

The major market barriers addressed by the ENERGY STAR™ Appliance program include:

- Lack of consumer awareness of the energy and other benefits of ENERGY STAR
- Appliances;
- Lack of retailer/supplier interest in and support for ENERGY STAR appliances;
- Lack of builder/contractor interest in and support for ENERGY STAR appliances;
- Limited product availability; and
- Uneven product quality.

The ENERGY STAR Appliances program is designed to overcome many of these barriers including:

- Providing product rebates and other sales incentives (e.g., a $100 rebate on qualifying clothes washers);
- Leveraging utility investment to secure matching rebates and other considerations;
- Demonstration and promotion of product benefits;
- Comprehensive marketing and consumer education campaign;
- Point-of-purchase displays and materials;
- Manufacturer labeling of products by 2001;
- Product and sales training;
- Program integration with ENERGY STAR Homes;
- Assistance with design and with product selection; and
- Use of circuit riders to recruit retailers into the program.

The success of the regional clothes washer program has been significant since it began in 1997. In 1998, approximately 7% of clothes washers sold in Massachusetts were ENERGY STAR™ models. This market share increased to more than double in 1999, or 16% of all clothes washer units sold in the state. Further, largely as a result of the TumbleWash program, every appliance retail store in Massachusetts

selling clothes washers carried one or more ENERGY STAR™ models in 1999. These changes in market share of higher efficient clothes washers is a clear example of how ratepayer-funded programs are helping to transform the market for clothes washers.

In addition to clothes washers, the ENERGY STAR™ Appliance program includes dishwashers, refrigerators, and room air-conditioners. In 1999, the program provided information and labels for use by retailers to identify which models of these appliances met the ENERGY STAR™ efficiency guidelines. The program required that all of these appliances be at least 11% more energy efficient than required for the Federal Appliance Standards for each appliance. Given that these appliances comprise a significant portion of the residential electricity bill, these energy efficient appliances can reduce electricity-use significantly, and thus costs to customers. No rebates were provided as part of this program, and focus was on customer education and retailer training.

2.4 Residential Information and Education

Ratepayer energy efficiency funds were used to educate residential customers about the benefits of energy efficiency and the opportunities for saving money through a number of venues. These included the Energy Smart CD and numerous publications.

Energy Smart CD and Web Site Software -- This program allows customers to understand their energy use by entering information into a computer program that does an energy audit. The audit includes information on heating, cooling, appliances and lighting. For customers that don't have computers some companies provided a mail-back survey to gather the information required for the audit.

Other Educational Activities/Publications -- Newspaper ads and distribution company web-sites were also used to inform customers, regulators, state agencies, and other regional energy partners of customer education initiatives. A number of the distribution companies also made high-efficiency products and information readily available to residential customers through home product catalogs, including the energy efficiency publication "Consumer Guide to Home Energy Savings."

Energy Conservation Services -- The Energy Conservation Services (ECS) is a state mandated efficiency and education program that provides various conservation services to residential customers. The program targets customers in 1-4 unit dwellings and multifamily dwellings with 5 or more units and mobile homes. For 1-4 unit dwellings, the program provides home energy audits, installation of selected energy saving materials, conservation education literature. For multifamily dwellings, the program provides building energy audits and workshops on energy maintenance for building management personnel. The program uses various mass-media and direct customer contact methods, including bill inserts, and provides fully subsidized and up to $30 of materials that demonstrate energy efficiency improvements. This program is administered by the Division (pursuant to M.G.L. Chapter 164 App §§ 2-1 to 2-10), and requires Department approval regarding the reasonableness of the program's budget.

In 1999, there were over 36,000 residential energy audits conducted through all the administrators' ECS programs[53]. In 1999 the Division worked with key stakeholder groups to develop draft regulations to convert the Energy Conservation Services Program to the Residential Conservation Services (RCS) Program, with the intention of providing a less expensive educational component and an on-site audit designed to encouraged the customer to invest in energy efficiency improvements.

[53] In addition to electric investor-owned utilities, gas investor-owned utilities and municipal utilities provide ECS audits.

3. Commercial & Industrial Programs

3.1 C&I Retrofit Programs

The majority of spending for C&I customers in 1999 was on retrofit programs, which were available to large, medium, and small C&I customers. Generally, retrofit programs encourage the replacement of outdated and inefficient electrical or mechanical equipment before the end of its useful life. These programs also provide financial assistance, as well as education, project design, and commissioning services. Program Administrators typically offer a Large/Medium C&I retrofit program, and a Small C&I program.

Large/Medium C&I Programs: Experience indicates that the retrofit market serving these customers is significantly self-sustaining. Especially for Large C&I customers, participation levels in retrofit programs is generally high – around 55 percent over a 10-year period for some companies – relative to medium and small C&I customers. Still, a number of barriers exist in the large C&I retrofit market that preclude customers from adopting optimal efficiency. These barriers, which also typically apply to the medium C&I market, include:

- Barriers unique to certain sub-segments such as educational institutions;
- Cumbersome competitive procurement requirements among certain customer segments (e.g., state and local government);
- Lack of clear, unbiased information about costs, savings and reliability of select technologies such as compressed air systems;
- Products and services that are currently unavailable (such as agents engaged in recommissioning);
- First-cost bias and lack of understanding concerning life-cycle costs;
- Transaction costs and time constraints (e.g., significant downtime from retrofit installation); and
- Split or misplaced incentives (e.g., building owners make capital investments while tenants pay energy bills).

Retrofit programs include elements designed to overcome many of the above barriers, including:

- Incentives to cover a portion of the equipment and labor cost to overcome first-cost barriers;
- Subsidized or free technical and design assistance to identify and analyze cost-effective efficiency opportunities;
- Customer and trade ally education; and
- Commissioning services to ensure installations perform as designed.

Further, retrofit programs play a role in educating medium and large C&I customers about new technologies, since technology is always changing. And while businesses may have participated in retrofit programs in the past, they may be retrofitting systems and equipment with technologies unavailable five years ago, and thus benefit from the ratepayer-funded programs.

Small C&I Programs: Small C/I programs target discretionary retrofit opportunities among existing customers, typically with peak demand less than 100 kW. Additionally, customers in designated economic development areas are targeted for inclusion into the program. The program identifies cost-effective efficiency retrofit opportunities and provides direct installation, financial incentives, and other strategies to encourage the early replacement of existing equipment with high efficiency alternatives, as well as the installation of new equipment such as lighting controls. All energy-using

systems are eligible for improvements, including lighting, refrigeration, domestic hot water and HVAC. Where appropriate, retrofitting multiple and interacting end uses is coordinated to ensure optimal system design (e.g., re-sizing and replacement of cooling equipment at the time of a comprehensive lighting replacement).

Programs provide customers with resources to assist in all phases of their projects from exploration and planning through installation. Customer incentives are 80 percent of the total project cost to minimize the initial cost barriers confronting smaller businesses. For those customers that qualify for the economic development incentive, an incentive equal to 100 percent of the project cost is covered by program funds.

The major barriers to energy efficiency in the small C/I sector, particularly acute in economically distressed areas, include:

- High transaction costs faced by energy services suppliers in working with many individual, small businesses, and also faced by the customers themselves;
- Split incentives: the landlord who does not see the direct benefit of energy savings (the tenant pays the bills) may be unwilling to spend more on energy efficiency improvements;
- Lack of information about energy efficiency products and their benefits;
- Lack of capital for facility upgrades in general;
- Lack of awareness of the benefits of properly maintained HVAC systems to provide optimal efficiency;
- Lack of experience and training of existing HVAC contractors;
- Disproportionate focus on first costs, rather than life-cycle costs; and
- Economically challenged areas traditionally under served by the industry.

The Small C&I programs include elements designed to overcome these barriers including:

- Financial incentives;
- Use of direct install contractors to target specific areas;
- Working with agencies involved with economic development customers;
- Audits and installations performed by contractors selected by the impartial utility through a competitive bidding process;
- Engineering and construction management services for unique, custom measures including development of comprehensive design projects; and
- Contractor use of "neighborhood" marketing to achieve marketing and implementation synergies.

The extent to which the small C&I sector has participated in retrofit programs varies across Program Administrators. Due to the greater challenges (e.g., higher costs) of reaching these customers, participation rates have not been as high relative to larger C&I customers.

3.2 C&I Lost Opportunity (New Construction) Programs

Lost opportunity programs typically offer C&I customers the opportunity to receive financial assistance as well as education, technical assistance, and commissioning services for projects such as new construction, extensive renovation jobs, and replacement of failed equipment. These programs encourage the adoption of design features, and selection of equipment, that optimize the efficient use of electricity. The intent is to help customers overcome the first-cost barrier and other barriers to invest in energy efficiency. The equipment and systems to be upgraded are limited only by cost-effectiveness criteria and customer acceptance of the technologies. In general, these products include lighting, variable

speed drives, building envelope measures, controls, energy management systems, HVAC, and process redesign/improvement. Additionally, a component of the new construction program includes marketing and implementation of regional programs in conjunction with the application process.

The major barriers to investing in lost opportunity projects in the C&I sector include:

- Disproportionate focus on first costs rather than long term costs;
- Lack of clear, unbiased information about costs, savings and reliability;
- Product and practice unavailability;
- Split or misplaced incentives (*e.g.*, developer will not pay energy bills);
- Disincentive for designers to incorporate energy efficient technologies into building design based on methods of remuneration; and
- High transaction and information costs.

During 1999, the Program Administrators offered lost opportunity programs to all C&I customers. These programs included elements designed to overcome these and other barriers including:

- Incentives to cover between 75 to 100 percent of the incremental cost of improved efficiency and related design services;
- Subsidized or free technical and design assistance to identify and analyze cost effective efficiency opportunities;
- Provision of information to customers;
- Marketing and outreach to vendors and design professionals to increase product and practice availability and capability, and to encourage trade ally promotion of efficiency to their clients; and
- Education of customers and design professionals about potential capital cost savings through system downsizing when energy efficient strategies are utilized.

3.3 Massachusetts Commercial Building Code

The influence of ratepayer-funded energy efficiency programs on building design and construction practices, as they relate to the energy code, is well recognized by the government and private entities who work with codes on a day-to-day basis. Improvements to the energy sections of building codes and to standards solidify the gains in design and construction practices created by the various energy efficiency programs. In July 1999, the Massachusetts Board of Building Regulation and Standards (BBRS) adopted a wholesale revision to the commercial building code in Massachusetts (CMR 780), which was delayed to January 2001. The new code is based on the national standards of ASHRAE 90.1-1999 and IECC 2000. Adoption was delayed to allow for the affected communities to be alerted to the new code and for them to attend training sessions during year 2000.

The Program Administrators have participated on BBRS' Energy Advisory Committee (EAC) that produced the changes to the commercial building code, and provided a letter to the Board supporting the adoption of the changes. In parallel with this effort, the Program Administrators actively followed the revision process for ASHRAE/IES Standard 90.1 and participated on a Regional Energy Code Advisory Committee. Program Administrators will continue to participate on the EAC to interpret and clarify the changes to the revised code, to propose additional changes, and to work on requirements for existing buildings.

Market barriers to effective implementation of enhanced building energy codes include the following:

- Higher first costs in construction due to code changes may cause a resistance to proposed changes from builders, architects and owners;
- Historically, compliance with enacted building energy code changes has suffered due to inconsistent interpretation and application;
- The BBRS has very limited training and technical support resources making introduction of new codes difficult; and
- Inconsistency in municipal code enforcement due to limited resources and the wide range of knowledge and experience within each building official's office.

The Program Administrators' initiative in commercial building codes and standards includes elements designed to overcome many of these barriers including the following:

- Support BBRS' training and outreach on the changes to Chapter 13 of the State Building Code;
- Provide training and outreach on the changes to commercial building code to increase awareness of the new requirements in design and construction communities in order to expedite compliance;
- Participate in the code process on local, regional and national levels; and
- Network with other regional entities to discuss areas of cooperation to improve the levels of energy efficiency in the built environment.

3.4 C&I Regional Market Transformation Programs

Massachusetts distribution companies participated in several statewide C&I Regional Market Transformation (MT) initiatives in 1999, coordinated through regional entities such as the Northeast Energy Efficiency Partnerships (NEEP). These included programs for premium efficiency motors, high efficiency commercial unitary HVAC, and training and lighting design guides to promote high quality energy efficient lighting. Where appropriate, program development was also coordinated with national and regional organizations such as the U.S. DOE Motor Challenge program and initiatives sponsored by Consortium for Energy Efficiency (CEE). These programs were largely coordinated through the Program Administrators' existing C&I retrofit and lost opportunity programs.

Premium Efficient Motors. The principle objective of the Premium Efficiency Motors Initiative is to establish high efficiency, premium motors as competitive products, broadly available in the regional marketplace for electric motors (1 to 200 horsepower). Qualifying premium motors reduce motor energy use by about 2 percent compared to standard motors that minimally meet federal standards. These electric motors consume 50 percent of the Northeast's C&I electric energy resources.

The Massachusetts Program Administrators worked with regional partners to develop and implement a regional program which, through strategic intervention in the marketplace, attempts to make premium efficient motors the product of choice for new and replacement motors. This program offers all C&I customers a rebate on installation of premium-efficiency motors that meet CEE's national standard. The regionally consistent program uses common eligibility requirements, common customer incentives, and consistent marketing campaigns throughout the Northeast. Marketing of the program was targeted at motor dealers through a circuit rider. In 1999, a total of 60 Massachusetts dealers actively participated in the program.

High Efficiency HVAC. In 1999, Massachusetts Program Administrators joined with other utilities in a NEEP-facilitated regional initiative to establish energy efficient packaged HVAC equipment and

installation practices as the product/service-of-choice for new and replacement installations. The initiative coordinates trade allies (such as equipment manufacturers, distributors and dealers), utilities, and commercial, industrial and institutional energy users in New England in a consistent program of strategic market interventions. Over time, this initiative will increase the availability of, and demand for, high efficiency HVAC products.

Through the High Efficiency HVAC initiative, a regional circuit rider is currently informing packaged HVAC retailers about the program. The circuit rider also distributes and processes the appropriate rebate forms. Rebates are designed to cover the entire incremental cost associated with the difference in cost between the premium high efficiency HVAC unit and the standard unit being replaced. This initiative is also exploring various ways to encourage HVAC contractors to follow energy efficient installation and service practices.

Commercial Lighting Design Guides. All Massachusetts electric distribution companies participated in the NEEP regional market transformation initiative on commercial lighting in 1999. This initiative undertook, first, to better understand how lighting decisions are made when buildings undergo a naturally occurring activity such as new construction, major renovation or through a periodic remodel. In an effort to affect these decisions, Program Administrators worked with NEEP through the *DesignLights Consortium™,* to develop commercial lighting design guides that can be used as templates, or patterns, for high quality energy efficient lighting design. These guides were developed with input from electrical contractors, designers, and building owners with the goal of making high quality energy efficient lighting designs more commonplace as buildings are newly constructed or go through remodeling or renovation.

3.5 C&I Load Management Programs

In 1999, several Program Administrators offered load management programs to their customers. These programs mostly funded C&I interruptible credit service programs, in which large C&I customers were paid credits if they agreed to reduce their electricity load when called upon by their distribution company during capacity shortage or emergency situations. In 1999, participating customers received $3.8 million in interruptible service credits, providing them with immediate savings on their electricity bills. In addition, the associated demand savings of over 56 kW to the distribution companies also helped to maintain system reliability, thus benefiting all customers. These programs are currently closed to new customers and end by January 1, 2001.